

STROKE IN SASKATCHEWAN: A REGIONAL SAMPLE

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By

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ABSTRACT

The latest evidence indicates that 50,000 Canadians will experience a stroke in 2013. The hospital care, rehabilitation, and long term care associated with a stroke places a significant burden on our health care system. Lost productivity and premature death have an immeasurable impact on communities in our province as well as the rest of the country. Small, less populated regions such as Saskatchewan may be underrepresented in national data utilized in the development of national prevention and treatment strategies across the country. The absence of local research has necessitated the use of national information to guide prevention, treatment education and programming in Saskatchewan.

The goals of this study was to provide a descriptive profile of stroke and transient ischemic attack cases admitted to Royal University Hospital over the period of April 1, 2009 to March 31st, 2010 and to assess the acute management of these cases as defined in the Canadian Best Practice Recommendations for Stroke Care (Strategy, 2010). A randomized sample of 200 cases 55 years and older was selected for a retrospective descriptive study involving review of adult stroke case records. Personal demographics and healthcare performance through the use of measures provided in *The Canadian Best Practice Recommendations for Stroke Care* (Canadian Stroke Network (CSN) and Heart and Stroke Foundation of Canada (HSFC), 2010) were evaluated.

The results indicated many similarities to available national information on type of stroke, risk factors, gender, and age. Hospital adherence to national guidelines comparing selected indicators was exceeded in some areas, and met in most. The remaining indicators provide an opportunity for improvement and possibly more research.

This regional information supplements the available Canadian information and could be used to guide planning and care strategically targeting Saskatchewan residents and increasing their potential for success.

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DISCLAIMER

This study is based on de-identified information provided by the Saskatoon Health Region and the Royal University Hospital. The interpretation and conclusions contained within this document do not necessarily represent those of the Saskatoon Health Region or the Royal University Hospital.

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CHAPTER 1: INTRODUCTION

1.1 Background

The latest statistics indicate that approximately 50,000 Canadians will experience a stroke in 2010 with an associated cost of approximately \$27,500 per stroke (Go et al. 2010). The burden of this disease on our health care system is significant in terms of costs related to acute care, rehabilitation and long-term health care (Luengo-Fernandez, Gray, and Rothwell, 2009; Public Health Agency of Canada, 2009; Public Health Agency of Canada, 1993; Moore, Lix, Yogendran, Martens, and Tamayo, 2008). This cost does not take into account the lost productivity from disabilities and premature death that often accompanies a stroke event. The burden of stroke can be decreased in three ways. The first is preventing risk factor development by promoting healthy lifestyles and secondly the controlling of risk factors through lifestyle change and medical management to reduce the occurrence of stroke. The third means is to rapidly intervene with medical treatment when a stroke occurs using thrombolytics, medical expertise, and diagnostic technology. Health care resources vary between regions and rurality. Romanow (2002) noted in his report examining the future of health care in Canada that “rural communities often have difficulty accessing primary health care and keeping health care providers in their communities, let alone accessing diagnostic services and other more advanced treatments” (p. 161).

Stansbury, Jia, Williams, Vogel, and Duncan (2005) found that “national-level data are rarely sufficient to help determine the problems and differences relevant to smaller geographic areas and across heterogeneous minority groups” (p. 383). To improve regional-specific prevention strategies and the treatment of stroke cases within regions of Canada, cultural and environmental data unique to specific geographical areas of Canada should be collected (Wilson et al. 2001;

Kapral, Laupacis, and Phillips, 2004). More regional information on the prevalence of stroke in Saskatchewan and the response of the health care system in treating stroke could provide clues to the types of interventions needed and the potential for their success. To date, limited information is available on the characteristics of stroke management in central and northern Saskatchewan. The purpose of this study is to identify the nature of stroke and the management of individuals undergoing a stroke or a transient ischemic attack (TIA) diagnosis in a region of Saskatchewan that serves both rural and urban populations. It will also compare stroke management in this setting with the Canadian Best Practice Recommendations for Stroke Care (CSN and HSFC, 2010).

1.2 Objectives and Research Questions

Question One: What are the characteristics of the people experiencing strokes in Saskatchewan, relating to their age, race, gender, and independence, location of their home community, documented risk factors, and previous medications to control those risk factors?

Rationale: The case history obtained through the hospital record will provide a profile of the case including age, race, functional independence, risk factors, and prior management of those risk factors. The profile will offer insight into the effectiveness of current primary prevention strategies in the community.

Question Two: What types of treatments are provided to stroke cases at the Royal University Hospital and how do they compare to national guidelines for timeliness and comprehensiveness during the acute and hospital phases of care?

Rationale: Best practice recommendations have been developed to guide the management of stroke care (CSN and HSFC, 2010). It is useful when establishing local implementations of national guidelines to identify consistencies and inconsistencies with national recommendations.

The treatment stroke cases receive in Royal University Hospital will be compared to these recommendations for compliance of service delivery purposes.

CHAPTER 2: LITERATURE REVIEW

2.1 Relevance of Stroke

The latest statistics indicate that 16,000 Canadians will die from stroke in a year and that this number represents 15% of all the stroke victims during the same time period (Public Health Agency of Canada (PHAC), 2009). The cost of having a stroke in Canada averages approximately \$27,500 and 10% of all stroke cases will go on to require long term care for which the cost is currently undetermined (PHAC, 2009). Another 10% of stroke victims will achieve full recovery, and the majority will live with disabilities such as the minor weakness of a limb, wide ranging cognitive impairments, or the need for comprehensive nursing care and loss of bowel and bladder control (PHAC, 2009). Anecdotally, this national level statistical information has historically been assumed to be representative of Saskatchewan residents in the absence of evidence to the contrary.

2.2 Types of Stroke

Stroke is divided into two main categories of ischemic including transient ischemic attacks and hemorrhagic strokes that include intracerebral hemorrhage and subarachnoid hemorrhage.

2.2.1 Ischemic stroke

Ischemic stroke, that includes TIA, is the most common type of stroke is a blockage that cuts off blood supply to affected parts of the brain. Ischemic strokes are often referred to as cerebrovascular accidents (CVA) and could be a thrombotic or embolic event. The effects of the blockage are related to the location of the blockage in the brain rather than the source; however the source becomes vitally important in identifying the cause for individual management and secondary stroke prevention (CSN, 2011).

A thrombotic ischemic stroke occurs when a diseased or damaged artery supplying blood to the brain forms a clot and pieces of that clot can break away and block a large or small vessel within the brain (Mayo Foundation for Medical Education and Research (MFMER), 2013). An embolic stroke is caused by a blood clot that has formed elsewhere in the body (emboli) becomes dislodged and travels to a cerebral artery (MFMER, 2013). When an embolic stroke occurs, there are almost immediate neurological and physical deficits. Emboli may be bacterial in nature, form as a result of cardiac arrhythmias (atrial fibrillation), vascular repair process, or are dislodged vascular plaques (MFMER, 2013).

A transient ischemic attack (TIA) produces stroke symptoms that resolve when the arterial blockage is dislodged or dissolved spontaneously without medical intervention. Hill (2004) considers TIA's to be high risk since 9.5% of those with a TIA will subsequently have a more severe ischemic stroke within 90 days. The opportunity for secondary prevention makes a TIA an extremely important medical event (Hill, 2004).

2.2.2 Hemorrhagic stroke

Intracerebral hemorrhagic stroke differs from an ischemic stroke in that it is caused by a ruptured blood vessel as opposed to a blood clot. The ruptured vessel interrupts blood flow and delivery of essential nutrients and oxygen to the affected area of the brain. A ruptured blood vessel may release blood very rapidly which may lead to a sudden build up in cerebral pressure resulting in unconsciousness or death. Approximately 10-15% of all strokes are hemorrhagic and have an estimated 40%-50% mortality rate (Woo et al., 2004; Go et al., 2010).

Goldstein et al. (2001) determined that "hypertension is a major risk factor for both cerebral infarction and intracerebral hemorrhage (p. 281). Other causes of intracerebral hemorrhages include infections, trauma, abnormalities in the blood vessels and blood clotting deficiencies

(Woo et al., 2004; Kiely, Wolf, Cupples, Beiser, and Myers, 1993). Intracerebral hemorrhages are less common than ischemic strokes and only account for approximately 12% of stroke events (Woo et al., 2004; Kapral, Laupacis, and Phillips, 2004; Canadian Stroke Network (CSN), 2011). Another kind of hemorrhagic stroke is subarachnoid hemorrhage. This is similar to intracerebral hemorrhages in that such strokes are caused from a ruptured blood vessel; however these occur outside of the brain tissue itself and result in the subarachnoid space surrounding the brain to fill up with blood causing rapid loss of consciousness and a poor prognosis for full recovery (Reinhardt, 2010). The most common cause is the rupture of a cerebral aneurysm. Aneurysms may develop from birth or early childhood and grow very slowly over the years as a result of thinning and progressive damage of the artery walls (MFMER, 2013).

In summary ischemic strokes are the most common type of stroke in both men and women and has been linked to many underlying influences known as risk factors. Mortality appears higher with those who develop hemorrhagic strokes.

2.3 Risk Factors

A stroke risk factor is something that increases your chances of developing a stroke. Sometimes the risk is a result of personal choices such as smoking, and other times the risk is from non-modifiable factors such as age (O'Donnell et al., 2010; Goldstein et al., 2001). Certain types of stroke have slight differences in associated risk factors. For example, obesity is associated with cardiovascular risk leading to ischemic strokes, while hypertension is linked to both ischemic and hemorrhagic stroke (Goldstein et al., 2001). Risk factor analysis is crucial for reducing stroke incidence.

Stroke prevention focuses on risk factors that can be managed through pharmacotherapy and those responsive to lifestyle modification (CSN, 2011, O'Donnell et al., 2010, O'Rourke et al.,

2004). For example hypertension and high cholesterol may be controlled through lifestyle modification and/or medication. For the most part, lifestyle adjustments for healthier living target lower salt intake, increased exercise, and smoking cessation (CSN, 2011). The identification of the risk factors associated with cardiovascular disease and stroke have been developed over time by studying large numbers of cases and recording their health history into data bases to find common patterns (O'Donnell et al., 2010; Wolf et al., 1991; Goldstein et al., 2001).

2.3.1 Non-modifiable risk factors

Non-modifiable risk factors include all risk factors for stroke that cannot be affected by individual behaviors. These factors include age, family history, ethnicity, and disorders for which there is no known direct cause. The significance of these factors is outlined in the following subsections.

2.3.1.1: Age

Age is an important risk factor that cannot be modified. Most individuals who have a stroke are over 65, although the average age of stroke victims continues to decrease (Public Health Agency of Canada (PHAC), 2010). The chance of having a stroke approximately doubles for each decade of life after age 55, and while stroke is more common among the elderly, an increasing number of people under 65 are also having strokes (Asplund et al., 2009). Telman, et al (2010) conducted a study of 656 stroke and TIA cases in Israel from 2001 to 2008 who were under the age of 65. They found the mean ages of TIA cases and stroke cases were 50.6 +/- 7.5 years and 51.3 +/- 7.6 years respectively. A limitation of this study was that there was no information provided on the frequency of stroke in the over 65 age group who are at high risk of stroke as well. No age is exempt from stroke and when combined with more controllable risk factors such

as hypertension, the combination is more important than age alone (Goldstein et al., 2001; O'Donnell et al., 2010).

2.3.1.2: Family history

Family history has been found to be a factor in ischemic as well as hemorrhagic strokes.

Hereditary factors may be genetic, but environmental and learned lifestyles may also play a part (Meschia, 2006; Dichgans, 2007). Taking learned behaviors into account makes this factor more complicated than genetics alone. Eating, drinking and exercise habits could explain part of why strokes may appear to have a familial connection. Information on the connection between parental strokes and strokes experienced by their offspring has been riddled with conflict regarding the relative contribution of shared genetic and environmental factors (Kiely, Wolf, Cupples, Beiser, and Myers, 1993). It should be mentioned here that studies searching for a genetic link have limited the age of participants to minimize the effect of degenerative changes associated with aging on study results.

In 1993, the Framingham study searched for a familial link and their results were inconclusive regarding the role of environmental and genetic influences on familial tendencies for stroke (Kiely et al., 1993). Seven years later, a second finding was published on a familial link from the same study. The number of stroke occurrences by that time gave the researchers the statistical power they needed to find a significant association between familial aggregation and stroke. The Framingham study is vitally important in establishing inherited risk because it is the only multigenerational study with verified occurrence of parental stroke (D'Agostino, Wolf, Belanger, and Kannel 1994; Kiely et al., 1993). Other studies have had to rely on history taking, death certificates or questionnaires (Aboyans et al., 2006; Besthorn, Wahle and Kirch, 2008). The

second Framingham study was able to identify a strong association between parental ischemic stroke and offspring ischemic strokes after adjusting for other factors (Seshadri et al. 2010).

2.3.1.3: Heart disease

Arrhythmias of the heart, valvular disease, previous myocardial infarction, and congenital heart defects are noted as significantly increasing the risk of stroke or transient ischemic attack (Goldstein et al. 2001; O'Rourke, Dean, Akhtar, and Shuaib, 2004). Atrial fibrillation alone accounts for up to 15% of the strokes seen in Canada, and this number increases up to one third over the age of 60 (Heart and Stroke Foundation of Canada, 2010).

These uncontrollable factors contribute to the individual's total risk and the greater the number of non-modifiable risk factors, the greater the urgency in controlling modifiable risk factors outlined in the next section.

2.3.1.4 Ethnicity

The American Heart Association (2010) summarizes statistics gathered in the United States where associations between cardiovascular disease and ethnicity have been recorded (U.S. Department of Health and Human Services (USDHHS), Centers for Disease Control (CDC) and Prevention, National Center for Health (PNCH), 2006). In their 2010 statistical update, the report on prevalence by ethnicity shows 1.8% for Asians, 2.7% for Caucasians, 3.6% for Afro-Americans, and 3.9% for American Indians and residents of Alaska (Go et al., 2010). The report goes on to say that the prevalence rates for American Indians are considered unreliable (Go et al., 2010). No prevalence of stroke for Hispanics was reported. From a public health perspective, the National Health and Nutrition Examination Survey (NHANES) identified that the control (management) of high blood pressure is not as common in Afro-Americans as it is in Caucasian

populations even with the detection and treatment available for hypertension for both groups (Howard et al., 2006).

2.3.2. Modifiable risk factors

Modifiable risk factors can be controlled or eliminated through lifestyle changes and/or the use of pharmaceutical interventions.

2.3.2.1: Hypertension

Uncontrolled hypertension, defined as blood pressure $\geq 140/90$ mmHg for an extended period, is an important modifiable risk factor for stroke. Wolf-Maier, (2003) found that 27-28% of Canadians suffered from high blood pressure which is an improvement over previous studies although it still leaves considerable room for improvement. Hypertension increases the risk of stroke by two to more than four times, independent of other risk factors (Nguyen, Dominguez, Nguyen, and Gullapalli, 2010; Haseqawa, 2010; Dobesh, 2006; Powers, Oddone, and Grubber, 2008). This increased risk is a result of adaptive structural changes in the blood vessels increasing peripheral vascular resistance that may compromise circulation and enhance the risk for ischemic events (Woo et al., 2004). Hypertension also increases the risk of intracerebral hemorrhage resulting from damage to the fragile walls of the small arteries inside the deeper areas of the brain (Woo et al., 2004).

Controlling hypertension long term can result in a 33% decrease in the risk of stroke (Goldstein et al., 2001). Control of hypertension may require lifestyle changes such as increased physical activity, weight loss, alcohol moderation, smoking cessation, lower fat and salt in diets as well as the use of blood pressure lowering medications (Canadian Hypertension Education Program (CHEP), 2013). Adhering to such a regimen is difficult for many patients and one troubling statistic suggests that only about half of those who have prescribed medications actually take them consistently (Besthorn et al., 2008; Haseqawa, 2010).

In recent years, the role of salt in North American diets and its relationship to hypertension has become better understood (CSN, and HSFC, 2010). Efforts are being made to increase public awareness of sodium intake as one of the major contributors to hypertension, and the food industry is being encouraged to decrease sodium in prepared foods (Smith-Spangler, Juusola, Enns, Owens, and Garber, 2010).

2.3.2.2: Diabetes

The microvascular and macrovascular complications of diabetes create one of the most significant risk factors for ischemic stroke (CSN, 2011). The Honolulu Heart Program was fundamental in establishing the risk of stroke related to diabetes in a study conducted from 1965 to 1968 involving over 7000 participants and a 12 year follow up period (Abbott, Donahue, MacMahon, Reed, and Yano, 1987). They showed a 2.5 time greater risk of stroke in cases with diabetes, but at that time, it was only a suggestion that the reason for the increased risk was due to atherosclerosis. The confirmation of this suggestion came in the years to follow with further research (Burchfiel, Abbott, and Curb, 1998). Chronic high blood glucose was shown to lead to the development of atherosclerosis and subsequently stroke risk. Type II diabetes is preventable and can be controlled in many cases through diet, exercise, medication, and weight control (Lakka, and Laaksonen, 2007; James, Rigby, and Leach, 2004).

2.3.2.3: Obesity

Obesity has been recognized for some time as a contributing factor of hypertension. More recently, it is being examined at least in part as an independent risk factor for stroke. Strazzullo (2010) conducted a literature review of prospective studies for their evaluation of obesity in relation to stroke events. Findings showed a positive relationship between overweight, obesity and risk of ischemic stroke independent from age, lifestyle, and other cardiovascular risk factors.

The relationship between obesity and stroke was further defined with the results of the INTERSTROKE study that indicated “a much stronger association of stroke risk with waist-to-hip ratio than with body-mass index” (O'Donnell, 2010, p. 121).

2.3.2.4: Smoking

The relationship between cardiovascular disease, stroke and smoking has been well established in the literature. In a study by Aboyans et al. (2006) found that current smoking was the strongest predictor of the progression of arterial disease. Smoking is a leading cause of heart disease and is a known risk factor for stroke. Smoking is known to raise triglycerides in blood, damage endothelial cells that line blood vessel walls, cause thickening and narrowing of blood vessels and result in the formation of clots (U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2010), National Center for Chronic Disease Prevention and Health Promotion. (2010) Further to this, it has been found that inflammatory reactions to smoking are involved in the pathogenesis of atherosclerosis (Raupach, Schafer, Konstantinides, and Andreas (2006). All the studies found agreed that smoking is a major risk factor for stroke with the Framingham study finding a 30% increase in risk where the MORGAM study found nearly a two fold increase in risk of stroke with smoking (Asplund et al., 2009; Elias et al. 2006).

Smoking cessation programs, legislated restrictions and public awareness programs have had a profound effect on attitudes in the last ten years. The literature shows mixed reviews on the success of various programs. Program located in such areas as remote and lower socioeconomic communities have not shown the declines in smoking rates seen in other areas (Sarkar, Lix, Bruce, and Young, 2010; Borland et al., 2009; Zlatev, Pahl, and White, 2010; Evans and McCormack, 2012

2.3.2.5: Alcohol

The consumption of alcohol in moderate amounts of 1-2 drinks per day has been associated with a lower risk of ischemic stroke (Goldstein et al. 2001). No cause and effect relationship has been established between alcohol use and stroke but studies such as The Northern Manhattan Stroke Study have shown correlation between moderate use of alcohol and lower levels of low density lipoproteins (LDL) and lower blood pressures in individuals consuming small regular amounts of alcohol (Goldstein et al., 2001). There was no evidence to indicate an increased risk of ischemic stroke with moderate alcohol consumption however, there is also no evidence for recommendations to be made for non-drinkers to initiate consumption, and heavy drinkers continue to be encouraged to reduce or eliminate their alcohol use (Lindsay et al., 2010).

2.3.2.6: Dyslipidemia

Dyslipidemia is a term used to describe excessive levels of blood cholesterol that create plaque deposits on blood vessel walls (PHAC, 2012; O'Rourke, Dean, Akhtar, and Shuaib 2004). These fatty deposits can occur within the brachiocephalic or internal carotid arteries and cause narrowing of the artery that decreases blood flow to the brain and increases the risk of blockage (Go et al., 2010; PHAC, 2012; O'Rourke et al., 2004). The presence of this buildup is generally not treated unless the individual also has physical symptoms associated with it (O'Rourke et al., 2004). When this occurs, it can be surgically corrected through endarterectomy or by stenting (O'Rourke et al., 2004). More commonly, elevated cholesterol levels are treated medically through the use of statins, a type of medication to reduce low density lipoprotein (LDL) levels (Amarenco et al. 2009).

There has been controversy regarding the effect of fat intake as it relates to levels of cholesterol in the body and the ensuing relationship to cardiovascular disease and stroke (Gillman, Cupples,

Millen, and Ellison, 1997; Sauvaget, Nagano, Hayashi, and Yamada, 2004). Participants in the Women's Health Initiative diet modification trial made changes to diet alone, reducing the amount of dietary fat and increasing the intake of fruits, vegetables, and carbohydrates (Howard and Van Horn et al., 2006). The women were followed for greater than 8 years and yet researchers were still unable to show a decrease in cardiac disease or stroke. As noted by the researchers, it was possible that the lack of effect on the cardiovascular system may be a result of a combination of elevated cholesterol and other risk factors such as a lack of exercise (Howard and Van Horn et al., 2006). It should also be noted that in Japanese studies, where increased dietary fat intake did not appear to be associated with ischemic stroke, the normal diet is low in cholesterol and therefore, the increase in fat intake seen in those populations is still lower than most North American diets as noted by Gillman (1997) and Boden-Albala (2009). The studies suggest that a low fat diet is more useful in the context of a healthy balanced lifestyle and the risk of heart disease and/or stroke need to be managed on multilevels concurrently.

High cholesterol and heart disease has been well accepted for some time, and the majority of research, especially in North America shows a positive relationship between high levels of LDL and stroke (Goldstein et al., 2001; Hachinski et al., 1996; Strazzullo et al., 2010; Amarenco et al., 2009).

2.3.2.7: Metabolic syndrome

The risk factors for metabolic syndrome include hypertension, glucose intolerance, dyslipidemia, and abdominal obesity. Of these factors, high blood pressure is considered one of the key components (Boden-Albala and Elkind et al., 2009). Each factor carries with it its own risk of causing a stroke. In combination, these same factors carry an even greater risk making the

control of each risk factor even more crucial (Boden-Albala and Sacco, et al., 2008; Cronin and Kelly, 2009; Rodriguez-Colin et al., 2009).

Combinations of specific risk factors carry a higher risk and have been grouped into a category called metabolic syndrome. This clustering of risk factors serves as a predictor for cardiovascular disease and diabetes, in turn may prove to be a predictor of stroke as well (World Health Organization (WHO), 2006; Boden-Albala and Sacco, et al., 2008; Cronin and Kelly, 2009). The World Health Organization (WHO) definition of metabolic syndrome requires the presence of diabetes mellitus, impaired glucose tolerance, impaired fasting glucose or insulin resistance and two of; 1) blood pressure greater than 140/90; 2) dyslipidemia with specific limits for triglycerides as well as high and low density lipoproteins for men and women; 3) central obesity determined by waist circumference and 4) microalbuminuria as found in urine output (WHO, 2006).

The prevalence of the syndrome increases with age and the number of components involved. Cronin and Kelly (2009) estimate the relative risk of stroke to have a “5-fold increase in stroke incidence for those having all 5 components” (p. 3). This does not in any way minimize how each risk factor is managed but does imply emphasis on patient education for the compounding effect of multiple risk factors.

2.4 Global View of Stroke

The major cohort studies assessing the characteristics of stroke originated in Europe, North America and Asia with less comprehensive information from Australia, Africa and South America. In 1978 results from several significant studies identifying cardiovascular risk factors and incidence were presented at the Bethesda Conference in 1978 (Keys, 1980). Two prominent studies were the Framingham Heart Study (Massachusetts), and the Seven Countries study

(Finland, the United States of America, Japan, Greece, Yugoslavia, Italy and the Netherlands). Findings at this conference showed that rates of cardiovascular death were declining or stabilizing in some populations while increasing in others. On closer inspection of the studies it became apparent that there was wide variation and inconsistency in the definitions and populations studied within these investigations. As a result of the findings presented at the Bethesda Conference, the World Health Organization (WHO) recognized the need for long term monitoring of mortality, morbidity and risk factors associated with stroke occurrence. As a consequence, the WHO **MON**itoring of trends and determinants in **C**ardiovascular disease (MONICA) Project was undertaken across four continents in the 1980s and 1990s, and paralleled similar longitudinal studies that took place in the United States of America. MONICA sparked the interest of cardiologists, neurologists and epidemiologists around the world that in turn generated new research into treatment options and preventive strategies. This was followed by the **MON**ica **R**isk, **G**enetics, **A**rchiving and **M**onograph (MORGAM) study.

2.4.1 MONICA and MORGAM

The MONICA study involved a random population health survey to collect information on cardiovascular risk factors for stroke from 38 populations in 21 countries and encompassed 10 years of data collection on individuals 35 to 64 years of age (Tolonen et al., 2002). Information was predominantly collected from European countries where collection continued beyond the 10 year study period and in some countries continued until 2002. Population health survey data was compared to death rates recorded in hospital data bases and death records to verify the information gathered in the survey (Tolonen et al., 2002).

The MONICA project demonstrated that stroke rate decline observed in some populations and countries, as initially described at the Bethesda conference, were attributed to both improved

hypertension management and improved stroke treatment (Tolonen et al., 2002). The project also demonstrated that the proportion of variation in stroke trends observed between different populations could be explained by the variation of the trends in risk factors between the various populations (Tolonen et al., 2002).

The MORGAM study was a follow-up study to the MONICA project that collected further information on cardiovascular and stroke risk factors. It was initiated in 19 countries and involved the collection of data from 51,703 men and 41,992 women. Eight European countries which were part of the original MONICA study participated. Researchers who took part in the MORGAM study had the following hypotheses (1) the risk factors have similar effects in all 5 regions; (2) the risk factors have similar effects for men and women; and (3) the risk factors have similar effects for age groups <45 years, 45 to 54 years, 55 to 65 years, and >65 years at baseline (Asplund et al., 2009). Baseline assessments were completed and the participants were followed prospectively for all causes of mortality, non-fatal coronary disease, and strokes. The MORGAM study was completed in 2009 and was self-reported as being the largest prospective study of stroke events performed to date (Asplund et al., 2009). The results of the MORGAM Study showed that serum levels of cholesterol were not a significant predictor of stroke (Asplund et al, 2009). However, higher serum levels of high density lipoproteins (HDL) were found to decrease the risk of stroke during the follow-up period of the study (Alplund et al, 2009). Results from the study indicated that “for each 10-mm Hg increase in blood pressure, the risk of stroke increased by 23% to 29% however, these findings varied between populations and regions” (Asplund et al. 2009, p. 2323). The increased risk with smoking also varied greatly between sub-cohorts. They concluded that there are many similarities and differences between regional groups which may be explained by other more subtle influencing factors such as

regional socio-economic conditions, physical activity, and dietary factors that were not captured in the data (Asplund et al., 2009). These influences may have modified the impact of the medically defined stroke risk factors of hypertension and dyslipidemia (Asplund et al., 2009). Asplund et al, (2009) also found there were many reasons why stroke risk factors would have varying impact in different populations in the study and that the major confounders are age, sex and geography in addition to genetic variations and socioeconomic status.

The MONICA and MORGAM studies are two of the largest stroke risk factor studies completed with multinational, multi-ethnic, populations. One of the greatest limitations with large studies such as these is that the less developed countries that possess less communication and testing (equipment) technology are not able to contribute on the same level as more technologically advanced countries, limiting the ability to generalize results to all populations.

2.4.2 Sino-MONICA Study

The Sino-MONICA study was a prospective study of people living in China that investigated the incidence and prevalence of stroke and myocardial infarction following the methodology of the MONICA study. Men and women ages 35 to 65 were enrolled from 16 provinces of China and then followed for a 7 year period (Wu et al., 2001). The study was launched in 1987 following a 2 year pilot project, and results indicated the prevalence of stroke in men to be 59/100,000 and 52/100,000 in women (Wu et al., 2001). Wu et al. (2001) found that the prevalence of stroke was higher than results of other populations in the MONICA study while the prevalence of myocardial infarction was lower. The study also found that there were much higher rates of stroke in the smaller rural regions where the lack of technology and formal health systems could be found and that this may have had an influence on differences noted (Wu et al., 2001).

2.4.3 Framingham Heart Study

An important study in the understanding of risk factors associated with cardiovascular disease and stroke was the Framingham Heart Study which began in 1948 in the United States. It began as a cohort study of a Massachusetts community with several thousand healthy individuals participating in physical examinations and lifestyle interviews that would later be used to analyze for common patterns pertaining to the development of cardiovascular disease (National Heart, Lung and Blood Institute (NHLBI), 2013). Individuals returned every two years to update their history and be re-examined. The study has continued to expand and now includes offspring of the original cohorts as well as new residents of Framingham (NHLBI, 2013; Petrea et al., 2009). The investigators monitored age, systolic blood pressure, use of antihypertensive medication, diabetes, cigarette smoking status, history of cardiovascular disease (coronary artery disease, heart failure or intermittent claudication), atrial fibrillation and left ventricular hypertrophy (Elias et al., 2004; Kannel et al., 1981). The study identified hypertension as a pivotal risk factor for stroke, with substantial increase in stroke risk when combined with co-morbidities (Kannel et al., 1981). Although the majority of the cohort was Caucasian, the risk factors have proven to be valid even among other ethnic groups although the patterns of distribution may vary by ethnicity (Howard et al., 2006). The Framingham Heart Study has become the most widely used reference study for stroke risk analysis, and has been used extensively in international and national guidelines for cardiovascular disease prevention (Asplund et al., 2009). The Framingham Risk Score was developed initially to determine the 10 year risk for developing congestive heart disease including myocardial infarction and coronary death (D'Agostino et al., 1994). The risk factors used in the Score were age, total cholesterol, HDL cholesterol, systolic blood pressure, treatment for hypertension, and cigarette smoking. These indicators were later re-tested for their accuracy in predicting cerebrovascular disease and as a result, the Framingham Stroke Risk

Profile was developed (Wolf, D'Agostino, Belanger, and Kannel, 1991; D'Agostino, Wolf, Belanger, and Kannel, 1994; Elias et al., 2004). The profile was later refined to recognize the effects of treatment and the lowering of risk associated with the control of risk factors (D'Agostino et al., 1994).

The results of this study allowed researchers to develop a risk analysis scoring method which could be applied to populations with similar American profiles but cannot necessarily be applied to larger and more diverse populations (Boden-Albala and Sacco et al., 2008).

2.4.4 Northern Manhattan Study (NOMAS)

The Northern Manhattan Study (NOMAS) is a study of the population of Washington Heights in Northern Manhattan, New York (Sacco et al., 1998). It is an ongoing study, which began in 1990, and is based in the Neurological Institute of Columbia Presbyterian Hospital. The study has enrolled over 4,400 people from the surrounding community. The overall goal of NOMAS was to investigate stroke risk factors in different race and ethnic groups. NOMAS utilized interviews with patients, and other neurological examinations to gather information on multiple risk factors for stroke including obesity, dietary fat intake, and metabolic syndromes. NOMAS is an ongoing information base allowing concomitant prospective studies to take place which focus on a specific risk factor to follow among residents who have never experienced a stroke for a period of time or until a specific number of people have had a stroke event (Boden-Albala and Sacco, et al. 2008; Boden-Albala, Elkind, and White, 2009; Willey et al. 2009; Elkind et al. 2010). NOMAS continues to be a unique source of population information for stroke and associated risk factors including the role of ethnicity and lifestyle. The ethnic groups represented in this cohort include Caucasians, Afro-Americans, and Hispanics living in the same community. This ethnic diversity in the participants has provided additional information that was not

available in the Framingham studies and showed a two to three-fold difference in the incidence of stroke in Afro-Americans and Hispanics over Caucasians (Sacco et al., 1998). In later research Sacco, et al. (2005) found an increased incidence of stroke in the Afro-Americans and Hispanic population over the Caucasian population even after adjusting for hypertension, diabetes, and education.

2.4.5 The National Institute of Neurological Diseases and Stroke

The National Institute of Neurological Diseases and Stroke (NINDS) is a division of the National Institute of Health (NIH) in the United States (NINDS, 2013). Since 1977 NINDS has sponsored 28 Phase 3 trials to evaluate treatments of stroke for 44,862 stroke participants. The trials were designed to test drugs, devices, surgery, and behavioral intervention in stroke prevention, acute treatment, and rehabilitation (Howard, VanHorn, et al., 2006). Sponsored studies have found that in the black stroke population there was less control of hypertension than in the white population. They hypothesized that with increased hypertension awareness and treatment that the higher incidence rates among blacks might diminish over time (Howard, VanHorn, et al., 2006). One NINDS trial of note is the Reasons for Geographic and Racial Differences in Stroke (REGARDS) study (Howard, Cushman et al, 2005). This is an prospective population based enquiry intended to be of a national scope although recruitment of participants is concentrated in the southern American states. The study is designed to investigate the geographical and ethnic factors associated with stroke for the future development of culturally and geographically sensitive stroke information. Subjects for this study were enrolled from 2003 to 2007 and are contacted every six months by phone to enquire about stroke symptoms. Results from REGARDS are limited at present; however it has the potential to provide much needed information.

2.4.6 Canadian Research

For many years, stroke research in Canada has been concentrated in the eastern provinces, and for the most part was initiated by either pharmaceutical companies through clinical trials or by stroke neurologists scattered across the country. What was missing was an organized method of fitting the pieces of information into a more comprehensive body of evidence of Canadian populations at risk. In the last ten years, the face of stroke in Canada has become more clearly defined and strategies have been put in place to improve the inter-relatedness of information gained (Canadian Stroke Network (CSN), 2013).

The emergence of the CSN in 2000 brought together researchers, academics, front line clinicians, students, government, industry and the non-profit sector in a collaborative organization. The CSN is funded by the Networks of Centres of Excellence (NCE) with additional funding from private industry. In 2004 the CSN partnered with the Heart and Stroke Foundation of Canada (HSFC) to create the Canadian Stroke Strategy (CSS). The purpose of CSS is to promote an integrated multidisciplinary approach to stroke prevention, treatment and rehabilitation (CSN, 2013). The goal of the CSS was to support and promote each province and territory in the development of a provincial strategy.

A major initiative of the CSN was the development of a registry to gather stroke data from major stroke centres across the country (Kapral, Laupacis, and Phillips, 2004). Saskatoon participated in the initial phase which began in 2000 and collected data for a 12 month period. The registry gathered extensive data to characterize the entire stroke event from onset to completion of in-patient medical care, allowing investigators to obtain a clear understanding of the proportions of stroke-types and the prevalence of risk factors and quality of care (Kapral et al., 2004). This initial phase of the registry required patients and family to give written informed consent, which

proved to be a barrier to enrollment and created bias in participant selection (Kapral et al., 2004). Stroke victims who could not write their name due to literacy or physical barriers were eliminated, family members were not always available or willing to provide consent, and mistrust of the system eliminated many from cultural groups who were fearful of how the information would be used despite the explanation of de-identification by trained professionals (Tu et al. 2004). The second phase of the registry required sites collecting information to be financially supported by their local institutions, and at this point Saskatoon was not able to participate. The information gathered in the first phase and subsequent data collection phases, primarily from Ontario, has provided a wealth of information regarding useful guidelines for stroke care and areas for further research (Kapral, et al., 2004).

In 2006, the *Canadian Best Practice Recommendations for Stroke Care* were introduced (CSN and HSFC, 2006). The development of this document included an extensive review of international research and published evidence based best practice recommendations and guidelines. The literature was reviewed by working groups consisting of stroke experts in Canada and the literature categorized by evidence levels using the AGREE tool as outlined in the first edition of the document (CSN and HSFC, 2006; Lindsay et al., 2010). The recommendations have undergone bi-annual updates since that time to include new information and make the guideline more comprehensive (CSN, 2011; Lindsay et al., 2010). The recommendations provided in the guideline come with performance measures from which health centres are able to gauge the success of their actions to advance stroke care. Two of these performance measures from the acute phase of care were selected for further investigation in this research. The recommendations also include core performance measures for an indication of

overall performance of stroke care from which one measure was selected for evaluation in this research.

More recently, the CSN funded and conducted an audit of stroke care called, *The Quality of Stroke Care in Canada* using the data capture methodology developed for the Registry of the CSN (CSN, 2011). This research was based on a chart audit of 38,210 case charts from 295 hospitals across Canada for the 2008-2009 period. The audit included 13 Saskatchewan hospitals for a total of 1385 cases. This information was used to describe the quality of stroke care currently provided to stroke cases across Canada and to make recommendations on how it could be improved.

Manitoba has done some very interesting work with data linkages and in the process has provided new information on the incidence and prevalence of cardiovascular health risk and stroke in their aboriginal populations (Moore et al. 2008; Elias, O'Neil, and Sanderson, 2004; Jebamani, Burchill, and Martens, 2005). Their ability to link data bases has increased the local understanding of the impact of stroke in Manitoba. and such approaches to study through routinely collected health information could be useful in assessing regional and remote populations in other provinces. Remote populations in all provinces have the potential to be under represented with the prominence in provinces with less funding and already poor representation.

In summary this review of the literature identified several risk factors with the occurrence of stroke in populations from different parts of the world. Little is known about the relevance of this information for Saskatchewan populations. The information profiling the stroke case in Saskatchewan is missing from the planning of programs and services for stroke prevention and treatment. The studies reviewed show that in addition to the more common risk factors for

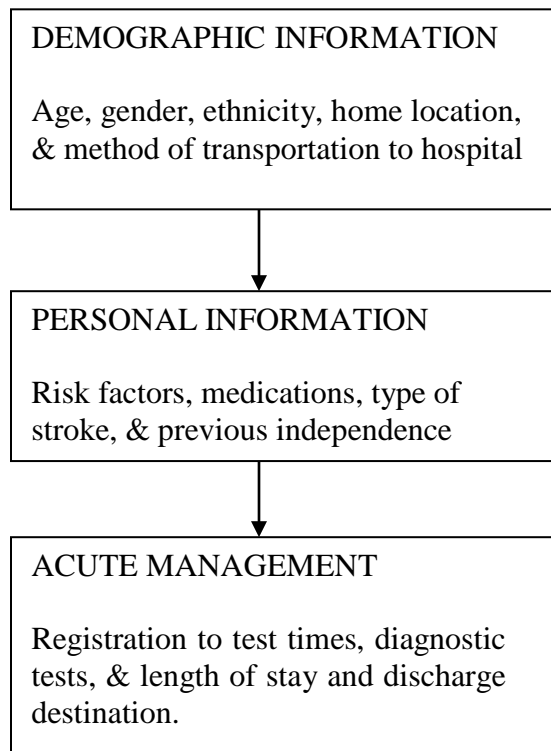
stroke, ethnic and geographical factors are important to identify when characterizing stroke morbidity. The sampling of stroke cases presenting to Royal University Hospital, the designated stroke centre for the central and northern regions of Saskatchewan, will help to identify the uniqueness of the regional information and the potential needs and population characteristics that can be used for a more encompassing regional stroke surveillance system.

2.5 Conceptual Model of Acute Stroke Care and Management

While prevention of stroke through better management of lifestyle factors remains a critical part of reducing stroke burden, there are characteristics within a stroke event that can be helpful in the identification of future prevention and management strategies for stroke. Demographic, personal and acute management concepts are important areas in the assessment and management of an acute stroke event. The demographic variables establish the basic information of age and gender as well as providing information on the approximate length of journey for each case. Personal information looks at the health profile of individuals prior to the stroke event based on their risk factors and the medications prescribed to control these risk factors. Independence at the time of the stroke is used to compare to independence at discharge for an estimate of the impact of stroke in the sample. The variables included in the acute management category measure the performance of the Royal University Hospital in the treatment of acute stroke. The figure 2.1 describes the typical intervention and management of a stroke event and the information that is useful in improving localized response to a stroke event. There are two phases that should be examined in developing strategies for future stroke care that are reflective of the local characteristics and needs in stroke management. The immediate care phase identifies the health characteristics of the population being admitted to hospital with stroke, examines the use of interventions, and measures the performance of the institution in meeting national

recommendations for stroke care. The second stage involves the use of local information to supplement information provided through national sources. This information is for use in the improvement of care through evidence based modifications to local programs.

Immediate Care



Strategies for Planning Response to an Acute Stroke

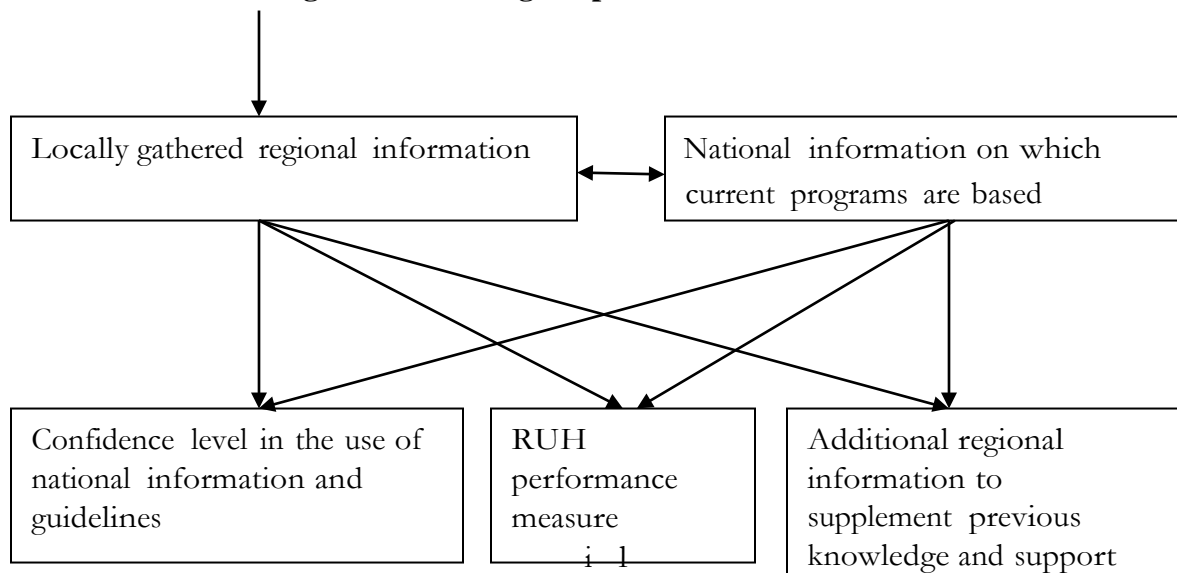


Figure 2.1

Conceptual model of stroke care and management

CHAPTER 3: METHODOLOGY

3.1 Study Design

This is a retrospective descriptive study design involving the review of stroke case hospital records.

3.2 Study Population and Setting

The population selected for this study was all stroke cases over the age of 55 years, who were admitted to the Royal University Hospital (RUH), Saskatoon, Saskatchewan for treatment April 1, 2009 to March 31, 2010 formed the population for the study. The Royal University Hospital represents the regional stroke centre for the central and northern regions of Saskatchewan because of the availability of neurologists, neurosurgeons, and diagnostic services required for stroke management. For this reason and because it is representative of other similar regional stroke centres across Canada, the Royal University Hospital was selected as the site for this research project. During a recent audit of stroke management in Canada, Royal University Hospital admitted more than 30% of all strokes in Saskatchewan to its' emergency department and in-patient units (Canadian Stroke Network (CSN), 2011).

3.3 Ethical Approval

Approval was received from the University of Saskatchewan Biomedical Research Ethics Board November 23, 2011 and from the University of Saskatchewan Department of Research and Innovation (Saskatoon Health Region) November 30, 2011.

3.4 Study Sample

Following ethics approval a request was submitted to the Strategic Health Information and Performance Support (SHIPS) department of the Saskatoon Health Region requesting the identification of all cases admitted to RUH that met the inclusion criteria outlined in Table 3.1

for the period of April 1, 2009 to March 31, 2010. An explanation of the International Classification of Disease (ICD) codes used in the inclusion and exclusion criteria is contained in Appendix D. Briefly, cases under the age of 55 were excluded as well as cases admitted to RUH who are not residents of Saskatchewan. The age exclusion for this study follows the framework for the identification of those individuals at sufficiently increased risk of stroke to warrant vigorous risk factor management developed by the Framingham study (Elias and Sullivan et al., 2004; Wolf et al., 1991; D'Agostino et al., 1994). Following the guidelines for definition of stroke as outlined in the World Health Organization Monitoring Cardiovascular Risk (MONICA) trial, any cases readmitted with 28 days with a diagnosis of a stroke or a TIA were excluded to distinguish one event from another (Tolonen et al., 2002). A total of 425 cases met the inclusion criteria. Due to financial restrictions, a sample of 200 cases was selected for analysis through the random selection function of the Statistical Program for the Social Sciences (SPSS).

Table 3.1*Inclusion / exclusion criteria*

Inclusion Criteria	Exclusion Criteria
Men and women >55yrs admitted with ischemic stroke, intracranial hemorrhage, and subarachnoid hemorrhage.	Men and women <55yrs of age
<p>Stroke as defined by ICD codes:</p> <p>-<u>All acute stroke</u> - 160 (exclude 160.8), 161, 163 (excluding 163.6), 164, 167.6, and H34.1, 163 (excluding 163.8), 164 and H34.1 (including acute but ill-defined cerebrovascular)</p> <p>-<u>subarachnoid hemorrhage</u> - 160, 161</p> <p>-<u>intracerebral hemorrhage</u> -G45(excluding G45.4)</p> <p>-<u>transient ischemic attack</u> – H34.0</p>	<p>Stroke as defined by ICD codes:</p> <p>160.8, 163.6, 163.8, and G45.4</p>
Residents of Saskatchewan	All cases who are not Saskatchewan residents.
First stroke event admission within a 28 day period	Men and women admitted with a second stroke event within 28 days of the first stroke event.

3.4.1 Refinement of the sample

Of the 200 randomly selected cases, three cases were identified as not meeting the criteria for inclusion in the study. The first case was admitted with a diagnosis of H1N1 and subsequently found to have possible small regions of infarction or demyelinating disease on computed tomography (CT). The second case was admitted under cardiology and had an incidental finding of an old infarct on CT. This case underwent an angiogram and subsequent bypass surgery with no further investigations by neurology and the third case was diagnosed with cerebral hemorrhage secondary to traumatic head injury and was transferred out of province for surgical treatment.

The diagnosis for three of the cases were coded as ischemic as well as hemorrhagic due to hemorrhagic transformation of their original ischemic stroke. In these cases, the hemorrhagic diagnosis was not used in the analysis. The remaining 197 cases were included in the analysis. Two additional cases were coded as both intracerebral and subarachnoid hemorrhage. It was determined that the original location of the bleed then spread to involve a second area. The originating location of hemorrhage was used in these cases.

3.5 Operational Definitions

Table 3.2

Definitions of variables examined in acute stroke management

Category	Variable	Operational Definition
Demographic	-age-----	->55 years
	-gender,-----	-male or female
	-ethnicity-----	Causasian, Aboriginal, Other
	-home location-----	-Saskatoon:Resident of Saskatoon city Urban/other: cities outside Saskatoon with CT scanners, rural -all regions without CT scanners remote rural:Athabasca, Mamawetin Churchill River, and Keewatin Yatthe.
	-transportation-----	-ambulance, private transportation air ambulance
Personal	-risk factors-----	physician report of – hypertension (yes/no/unknown), diabetes (yes/no/unknown), dyslipidemia (yes/no/unknown), obesity (yes/no/unknown), alcohol abuse (yes/no/unknown), and smoking (yes/no/unknown), and atrial fibrillation (yes/no/unknown) any in the following categories reported:
Personal (cont'd)	medications-----	anti-hypertensive (yes/no/unknown), clopidogrel (plavix) (yes/no/unknown),,Coumadin (warfarin) (yes/no/unknown),, Acetylsalicylic

	<p>-type of stroke-----</p> <p>independence level-----</p>	<p>Acid(yes/no/unknown), , oral glycemic (any) (yes/no/unknown),, Insulin, (any injectable) (yes/no/unknown),, anti-lipid (any) (yes/no/unknown).</p> <p>-ischemic or hemorrhagic as recorded in the physician assessment and confirmed in the reported on admission history</p> <p>independent prior to stroke (yes/no)</p>
Acute Management	<p>-Registration to test times-----</p> <p>diagnostic tests-----</p> <p>-length of stay-----</p> <p>-discharge destination-----</p>	<p>phlebotomy (minutes)</p> <p>CT Scan (minutes)</p> <p>transthorasic echocardiogram (yes/no) , carotid ultrasound (yes/no), CT angiogram (yes/no), Holter monitor (yes/no), and MRI(yes/no)</p> <p>-number of hospital days from admission to discharge as per the hospital record.</p> <p>-home, rehabilitation, long term care, home hospital, deceased in hospital.</p>

3.6 Data Collection and Tools

The collection of data began December 1, 2010 and was completed January 12, 2011. The data collection tool used for this study is provided in Appendix A. The process of abstracting data was performed as follows:

1. An abstractor was trained by the researcher to collect case information from the stroke case record using the data collection tool in Appendix A.
2. Health record numbers provided by SHIPS were used to locate the selected cases for the sample. The Health Records department of RUH provided 10 charts per day for the abstractor to review and record information into an individually numbered data record coinciding with each chart. Cross referencing of study data record to the health record for each case was recorded on an independent cross reference list. A separate unidentified list of postal codes and ID numbers was made to classify the health region from which each case originated as required by the University of Saskatchewan Ethics Department.
3. Study data records were scrutinized for completeness and 23 charts had to be recalled to clarify information from the original health record.
4. Each record was given a unique identifier and a master list was developed linking this number to the health record. A list was then made of the health regions corresponding to the postal codes obtained from the health record.
5. Data abstraction was deemed complete January 12, 2011 after which the original list of records provided by SHIPS, the cross reference list of hospital chart and study data record, as well as the list of postal codes and identification numbers were destroyed using a shredding machine.

As per the University of Saskatchewan protocol, the research data will be held by the thesis supervisor, Dr. Lalita Bharadwaj, in a locked cabinet in the College of Public Health for a minimum of five years.

3.6.1 Performance Measures

The Canadian Best Practice Recommendations for Stroke Care (CSN and HSFC, 2010) provides performance measures to assess the impact of implementing the recommendations for stroke care. The following 4 performance measures were selected for analysis based on the availability of information in the health record with one being a core indicator. Table 3.3 provides an overview of the guidelines, their performance measures and the variables used for evaluation.

Table 3.3

Definition of the guideline, performance measures and the operational definitions.

Guideline	Performance measure	Variable and Operational definition
1: All suspected stroke patients: complete blood count (CBC), electrolytes, creatinine, urea, glucose, international normalized ratio (INR), partial thromboplastin time (PTT), thyroid-stimulating hormone (TSH), fasting lipid profile, creatine Kinase (CK), troponin test.	Acute blood work, including routine chemistry, electrolytes, hematology and coagulation should be conducted as part of the initial evaluation	Registration to phlebotomy time / measured as the time from registration to the time of phlebotomy.
2: All patients with suspected acute stroke or transient ischemic attack should undergo brain imaging (MRI or CT) immediately.	The proportion of stroke patients who receive a brain CT/MRI within 60 minutes of hospital arrival.	Registration to CT time / measurement of time in minutes from the time of registration to the time of CT scan.
3: Core indicator – as an indication of overall institutional performance not attached to a guideline.	Distribution of discharge locations (dispositions) for acute stroke patients from acute inpatient care to: home (with and without services); inpatient rehabilitation (General or specialized); long term care; and to palliative care (each stratified by stroke type and severity).	Discharge destination / home, rehabilitation, long term care, home hospital, or deceased in hospital.

3.6.2 Analysis

Statistical analyses were performed using SPSS for Windows Version 17.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics including age, gender, type of stroke, etc. were calculated and used for reporting the results. Statistics used to describe the data included means (standard deviation), frequencies and percentages. For proportion of stroke by health regions, the population as described in the annual report of health regions for 2011 was used for the denominator.

CHAPTER 4: RESULTS

4.1 Description of Demographic

4.1.1 Description of the Population Admitted to RUH for Stroke and TIA

The results of the study showed that the diagnosis of stroke was divided comparatively even between men and women, with men (100) representing 51% and women (97) representing 49% of the sample. The mean age for men was 74.46 years \pm 10.3 SDA. This was slightly lower than the mean age of 79.08 years \pm 9.7 SD was found in females. The most frequent type of stroke was an ischemic stroke (72%) followed equally by TIA or intracerebral strokes (12% each). Figure 4.1 indicates that the percentage of men and women admitted to Royal University Hospital for stroke. More women than men were treated for a TIA or a subarachnoid hemorrhage while more men than women were likely to be admitted with an intracerebral hemorrhagic stroke. The distribution of ischemic stroke was slightly higher in men (53.0% versus 47%).

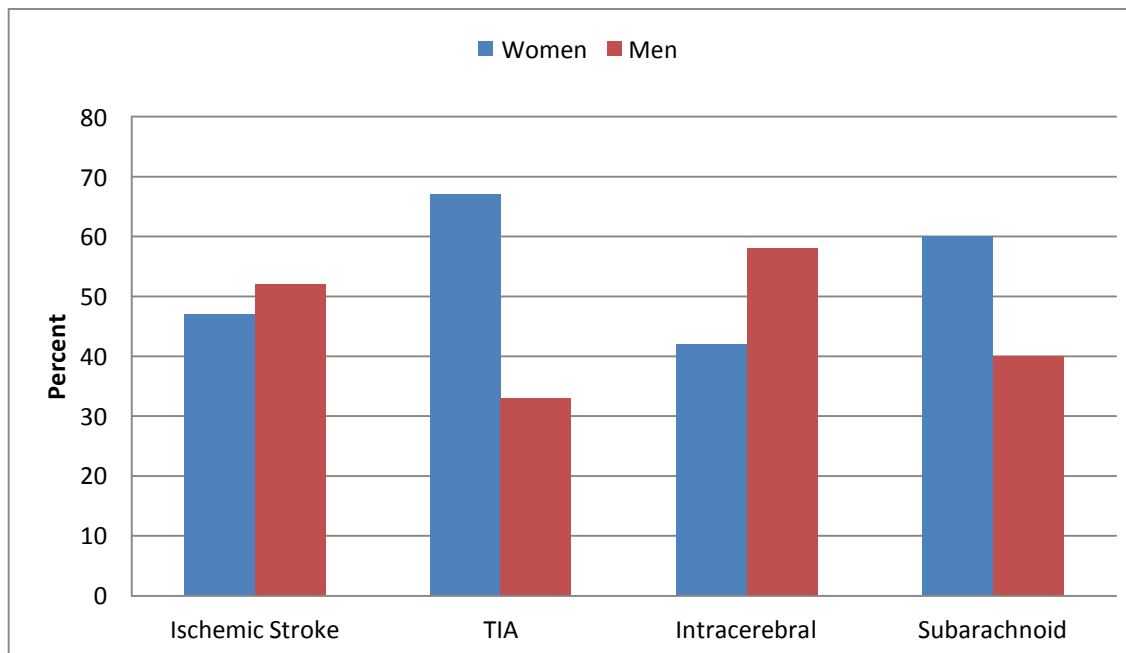


Figure 4.1
Proportion of stroke type by gender of 197 randomly selected cases from study chart audit Royal University Hospital 2009/2010

Table 4.1

Frequency of stroke sub-types by age and gender

Gender and Age	Ischemic Stroke n = 143	Transient Ischemic Attack n = 23	Intracerebral Hemorrhage n = 24	Subarachnoid Hemorrhage n = 7	Total n = 197
Women (n=97)					
55-65	8	1	1	2	12
66-75	12	3	3	0	18
76-85	30	4	5	2	41
>85	17	7	1	0	25
Men (n=100)					
55-65	18	2	5	1	26
66-75	25	1	2	1	29
76-85	18	4	6	1	29
>85	15	1	1	0	17

4.1.2 Stroke Cases by Residence

Of the total 197 cases included in the study, just over 80% were living independently at the time of their cerebrovascular accident with, 78 (49.3%) residing in Saskatoon. Fifty six (35.4%) of cases were living independently in rural areas, while 12 (7.6%) lived independently in urban centres outside of Saskatoon and 12 (7.6%) lived in remote rural areas. A total of 39 (19.8%) cases from all areas required partial or full care prior to the qualifying cerebrovascular accident. Transportation to hospital was categorized into three groups: ambulance, personal vehicle, and air ambulance services. Of the 197 cases included in the study, the majority 136 (69.0%) arrived

to hospital by ambulance. Fifty cases (25.4%) arrived by personal transportation and 11 (5.6%) arrived via air ambulance services. Data describing the gender, age, transportation, community and independence of the cases are provided below in Table 4.2.

Table 4.2
Description of demographic characteristics

Characteristic	Category- Demographic	Frequency (n = 197)	Percentage (%)
Gender	Male	100	50.8
	Female	97	49.2
Age in years	55-65	38	19.3
	66-75	47	23.9
	76-85	70	35.5
	85+	42	21.3
Type of transport	Ambulance	136	69.0
	Private	50	25.4
	Air ambulance	11	6.6
Community	Saskatoon	106	54.8
	Urban/other	13	6.6
	Rural	66	33.5
	Remote rural	12	6.1
Independence Prior to Stroke	Yes	158	80.2
	No	39	19.8

4.1.3 Description of health region representation by total population

The total population for each health region is included in their annual reports to the Minister of Health. Using these population numbers, the representation from each region was calculated as a per capita percentage to discover if this would change the ranking of highest to lowest

representation of stroke. The Saskatoon Health Region showed the highest percentage of cases in the study sample while Heartland had the highest percentage of cases per capita (Saskatoon Regional Health Authority, 2011). Athabasca Health Authority had the lowest number of cases in the sample but when used as a representation of the region's population, this region was the higher per capita percentage of either Kelsey Trail, Prairie North, or Parkland (Athabasca Health Authority Reports, 2006; Prince Albert Regional Health Authority, 2011; Prairie North Health Region, 2010; Kelsey Trail Health Region, 2010; Heartland Health Region, 2010; Mamawetan Churchill River Health Region, 2010; Keewatin Yatthé Regional Health Authority, 2010).

Table 4.3 shows the number of people arriving at Royal University Hospital from each of the health regions. In the table, urban centres are included in their respective health regions and Saskatoon includes the rural areas of the region. Of the 197 cases, 130 (62.9%) lived within the Saskatoon Health Region representing just over half of the cases identified during the time period between April 1, 2009 and March 31, 2010. Thirteen of cases (7%) arrived to hospital from the urban communities of Melfort, Prince Albert, North Battleford, Lloydminster, and Kindersley. Sixty six (33%) of cases arrived from rural communities. Twelve cases arrived to hospital from remote rural communities located in the Mamawetan Churchill River, Keewatin Yatthé, and Athabasca Health Regions

Table 4.3

Representation by Health Region

Region	Frequency n = 197	Percent of Study Cases per Region	Study Cases as a Percentage of Health Region Population (# per 1000)
Saskatoon (rural plus one urban centre)	130	62.9	44
Prince Albert Parkland (rural plus one urban centre)	5	2.5	6.4
Prairie North (rural plus 2 urban centres)	14	7.1	19
Kelsey Trail (rural plus 1 urban centre)	9	4.6	21
Heartland (rural)	27	13.7	63
Mamawetan Churchill River (remote rural)	5	2.5	22
Keewatin Yatthé (remote rural)	6	3.0	27
Athabasca (remote rural)	1	.5	22

4.2 Personal Characteristics

There were two categories that could not be used for analysis due to the minimal amount of data available. The first was ethnicity where there were only two charts with documentation. The second category was obesity where there was no reference to body weight in 138 of the charts (70%), another 45 (23%) had a documented history of no obesity and 13 (7%) documented cases of obesity.

4.2.1 Description of Population Risk Factors

Table 4.4 presents the frequency of common risk factors associated with a stroke case.

Hypertension was identified as the most frequent risk factor with (81%) of cases having a documented diagnosis of hypertension. Forty six percent of cases had recorded dyslipidemia, 29% had cardiac artery disease, and 27% had diabetes. Of all the cases identified, 31 were smokers (16%), and an additional 5% of cases reported having quit smoking in the last five years or less. Seventy nine percent of cases were non-smokers.

There were 37 cases (19%) that had a family history of stroke prior to their event. Of the 197 cases, 35 (18%) had a recorded history of at least one episode of atrial fibrillation and nearly one third had a noted history of previous stroke or TIA.

Twenty eight (14%) of the cases were noted to have had previous cardiac surgery; 12% had reported heart attacks and 7% (13) had reported congestive heart failure. Of the total 197 cases, 7% (13) reported alcohol abuse.

Table 4.4

*Personal risk factors reported in 197 cases of stroke between April 1, 2009 and March 31, 2010 at Royal University Hospital**

Risk Factor	Frequency n = 197	Percentage %
hypertension	160	81
dyslipidemia	91	46
cardiac artery disease	57	29
diabetes	55	28
atrial fibrillation	35	18
previous stroke	35	18
previous TIA	28	14
cardiac surgery	28	14
myocardial infarction	24	12
congestive heart failure	13	7
alcohol abuse	13	7
smoking- current	31	16
- no-stopped <5 years	11	5
family history	37	19

* Percentage does not equal 100 as many cases had more than one risk factor

4.2.2 Description of Gender Differences in Relation to Risk Factors

The literature indicates that multiple risk factors increase the risk of cardiovascular disease and stroke although the exact combination of factors is not clear (WHO, 2006; Boden-Albala and Sacco, et al. 2008; Cronin & Kelly, 2009). All agree that hypertension is the single most important factor and this was also in the sample taken from Royal University Hospital where 81% of the sample had a positive history as seen in Table 4.. The other major factors include

dyslipidemia, found in 46% of the sample and diabetes that was found in 27% of the sample (Cronin & Kelly, 2009; WHO, 2006). Abdominal obesity was also named as a critical factor but was not obtainable in the sample due to lack of documentation. Rodriguez-Colon et al. (2009) found the more metabolic syndrome components an individual has (up to 5 components), the higher the risk of a stroke.

The sample indicates that a large proportion of cases had 3 to 5 risk factors although it was not possible to identify if these risk factors were in fact the ones identified in the literature. The sample shows a larger number of men in the lower age categories with greater than 5 risk factors where women have more risk factors with age. Gender differences were minimal in relation to age. The average age for men having a stroke was 74 with a range of 55-95 years; while the average age for women was 79 with a range of 56-96 years at the time of their stroke. Figures 4.2 and 4.3 indicate the number of cases by age range and gender with three to five and greater than five risk factors per case.

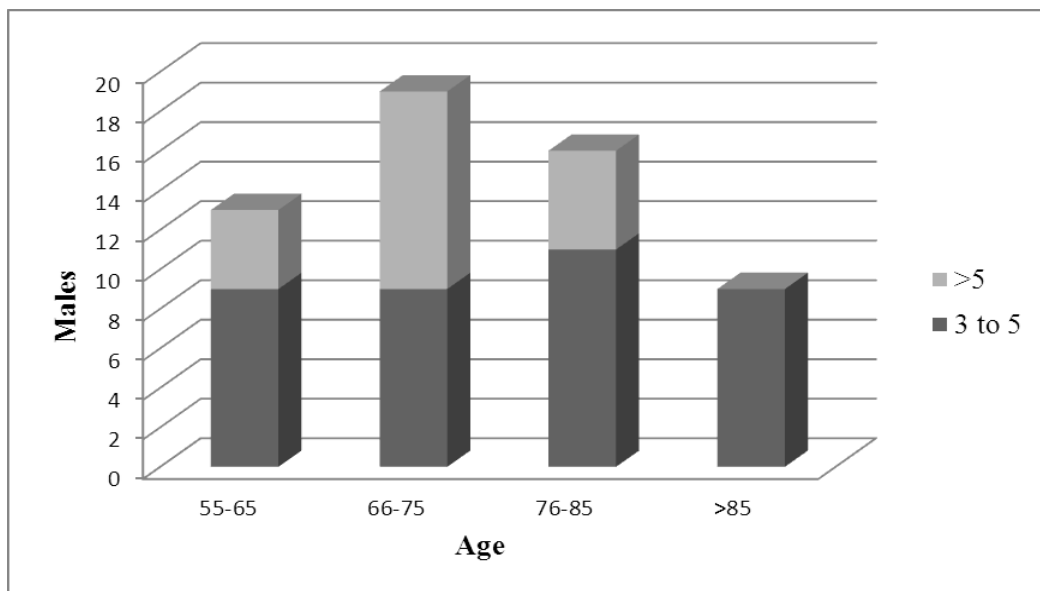


Figure 4.2 *Frequency of risk factors for stroke (>5 or 3 to 5) in males*

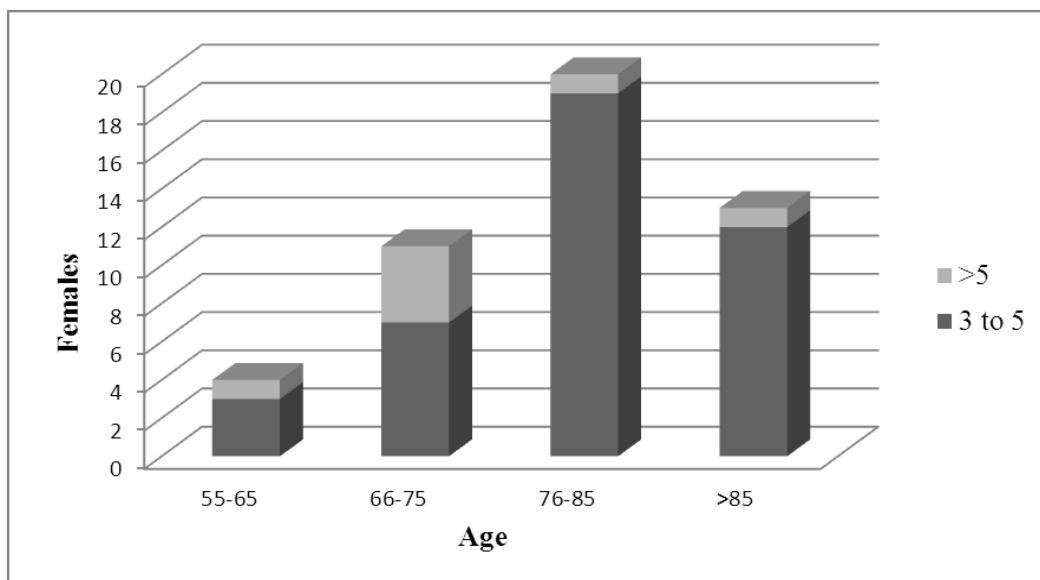


Figure 4.3 *Frequency of risk factors for stroke (>5 or 3 to 5) in females*

4.2.3 Description of medications used to treat risk factors

The medication reconciliation data base provided on admission was utilized to identify currently filled prescriptions for each case in the study. There were 35 cases of previous stroke and 28 cases of previous TIA in the case histories. Of the previous stroke cases, all were currently prescribed an antiplatelet or anticoagulant medication to prevent a second occurrence where only 78.6% of the previous TIA cases were currently prescribed any of these same medications for secondary prevention. One hundred forty two (89%) of the 160 cases with a diagnosis of hypertension were currently taking a medication identified as anti-hypertensive. Eighty cases (40%) were utilizing acetylsalicylic acid daily, and statins were used in 63 (67%) of the 94 cases with a documented history of dyslipidemia. An anticoagulant (Coumadin) was prescribed in 14 of the cases (7%) for use in the treatment of atrial fibrillation.

Case history data demonstrated that 55 (28%) of the cases were identified as having diabetes with 42 (76%) currently being treated with antiglycemic medication. Results show that of the known cases with diabetes, 32 (58%) were taking an oral glycemic medication, and 13 (24%) were taking an injectable form of insulin. These two groups of diabetic medications can be used concurrently as demonstrated by 3 cases who were treating their disease with both insulin and an oral glycemic medication.

4.3 Acute Management of Stroke Cases at Royal University Hospital

4.3.1 Description of arrival times as it pertains to therapy limitations

The time from stroke onset to arrival at hospital was grouped into five categories for the purpose of analysis. These include: i) 0-4.5 hr – eligible time for thrombolytic therapy; ii) 4.5-6 hours – improvements in process might have the potential to shorten the time to treatment; iii) 6-12 hours – interventional therapies may be an option for treatment up to 9 hours; iv) 12-24 hours; v) >24

hours useful for assessment of the magnitude of delays and possible gaps in education. See Figure 4.4 for the summary of arrival times.

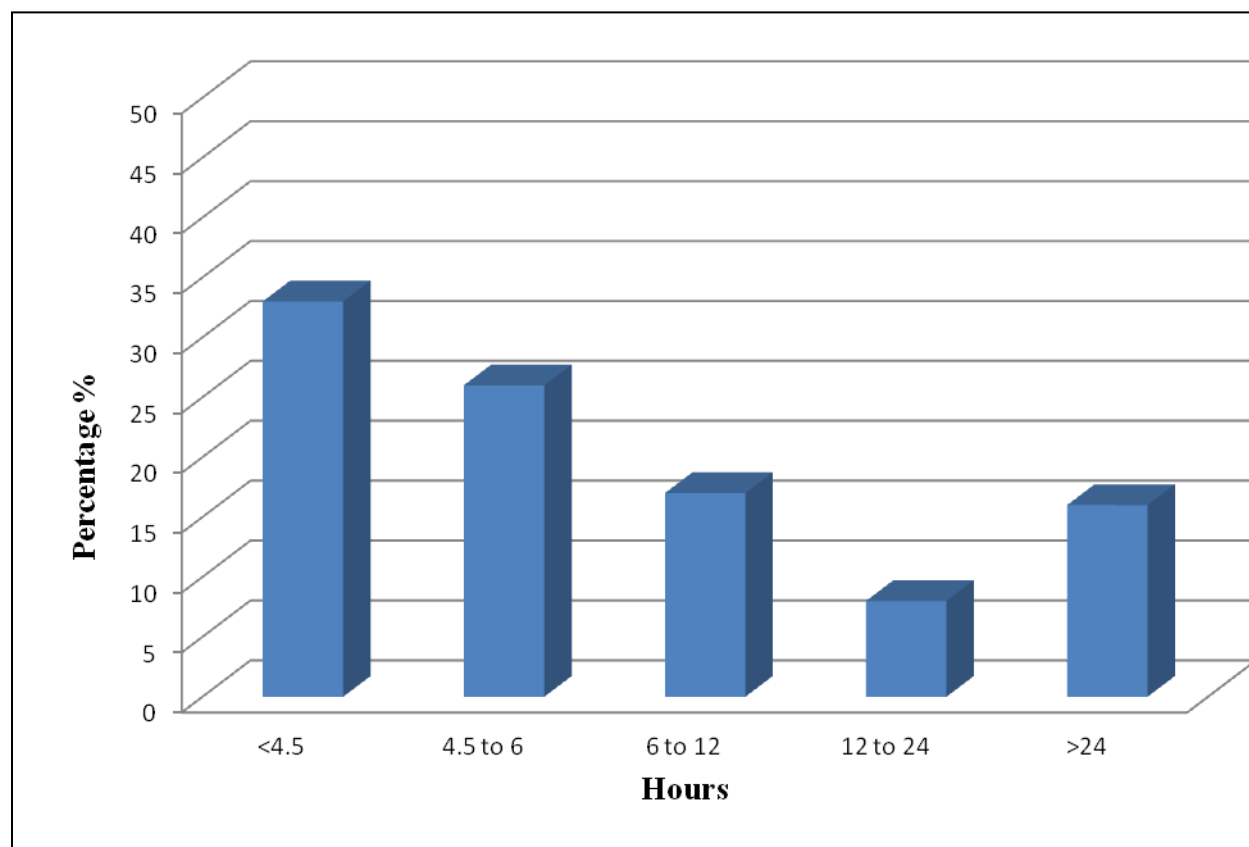


Figure 4.4 *Proportion of participants with different elapsed time from symptom onset to arrival at Royal University Hospital emergency room*

Arrival times noted in Figure 4.4 include all methods of transport. Of the 197 cases, 46 were treated elsewhere prior to transport to RUH or arrived at hospital greater than 48 hours after the stroke occurred and were therefore not included in this analysis of acute admissions. Of the remaining 151 cases seeking acute treatment, 20 (13%) received tPA.

Overall, sixty six of the 197 cases (33%) arrived at the emergency department in less than 4.5 hours following the onset of their symptoms. These individuals represent the percentage of cases

that were potential candidates for thrombolysis. Two thirds of cases did not arrive early enough for treatment. Fifty one cases (26%) reached hospital in the first 90 minutes past the treatment window of 4.5 hours. Thirty four (17%) cases arrived within the 6 to 12 hour time frame, 15 (8%) arrived to hospital within 12 to 24 hours and the remaining 31 (16%) arrived well out of the treatment window in greater than 24hours post symptom onset.

The arrival to hospital times were then examined based on the case's home community (SHR, urban, rural, or remote rural community). Fifty two of cases (42%) from the City of Saskatoon arrived at hospital within the 4.5 hour treatment window while 2 (15%) from urban centres outside Saskatoon arrived in this same time window. Twenty cases (30%) residing in rural communities arrived at Royal University Hospital in time to treat. There were no cases from remote rural areas that arrived within the 4.5 hour treatment window. Twenty six of the cases (24%) from Saskatoon missed the treatment window by less than 90 minutes as did 5 (39%) from urban centres outside of Saskatoon, 18 (27%) from rural areas, and 2 (17%) from remote communities. The majority of cases arriving from remote rural communities (8 or 67%) arrived between 6 and 12 hours post onset of symptoms, which was nearly four times longer than the 17% of cases arriving from rural Saskatchewan. Twenty three percent of the cases coming from urban centres outside of Saskatoon did not reach a RUH for greater than twelve hours. Both the urban centres located in rural areas and the cases originating in the City of Saskatoon, demonstrated 15% of cases arriving to hospital more than 24 hours after the onset of symptoms. This percentage was slightly higher (18%) coming from rural areas, and lower (8%) from remote rural areas. Figure 4.5 below shows the length of time it took individuals to reach Royal University Hospital from each of the study communities.

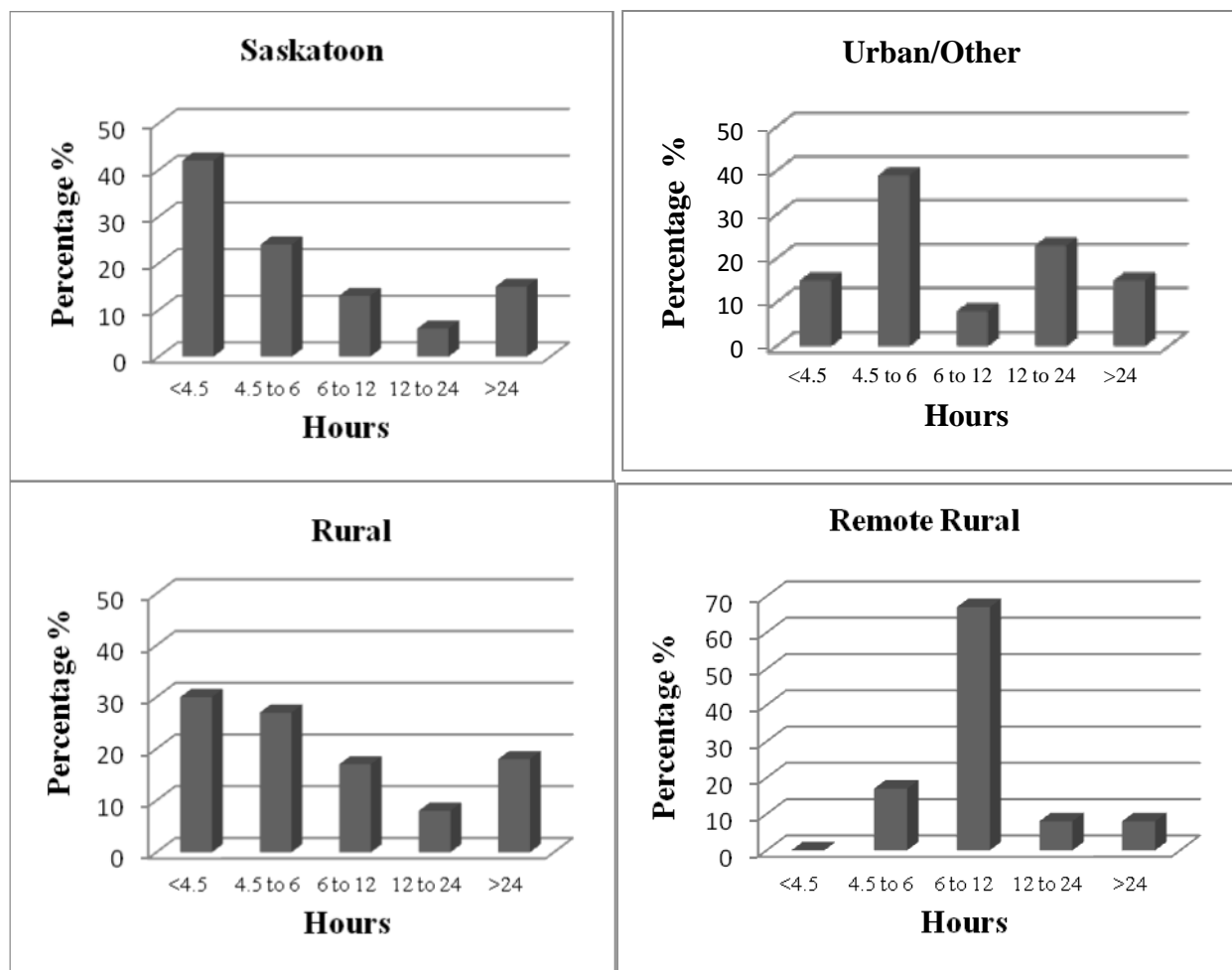


Figure 4.5

The percentage of stroke/TIA cases from each of the study communities and the length of time it took individuals to reach Royal University Hospital

4.3.2 Description of Hospital Response to Acute Stroke Admission

The time taken by staff to facilitate treatment when the case reaches hospital can be very important to outcomes. The recorded start times for computed tomography (CT), electrocardiogram (ECG), and phlebotomy reflect the response of staff to an acute stroke case. Forty seven cases (24%) were transferred from other sites and had computed tomography

completed prior to transfer. These cases were not included in this portion of the analysis to avoid bias. Other cases may not have had a CT done prior to arrival at hospital, but had an ECG (22 cases) or phlebotomy (23 cases) done at another facility or from a previous admission indicated by the number of cases included in the analysis. Tests completed prior to registration were not used in the analysis. Table 4.5 shows the maximum, minimum, mean and standard deviation for registration to test time.

Table 4.5

Elapsed time from registration in emergency at Royal University Hospital to test time

Correlate	Minimum	Maximum	Mean	Std Deviation
Registration to CT n= 150	0 min	6 hr 04 min	1 hr 01 min	1 hr 29 min
Registration to ECG n= 175	0 min	12 hr 10 min	1 hr 25 min	2 hr 2 min
Registration to Phlebotomy n= 174	0 min	7 hr 17 min	1 hr 6 min	1 hr 24 min

The time it takes to complete these tests is crucial in determining the cases eligibility for treatment with tPA which is currently the only non-surgical treatment available for acute stroke. The time from registration to the time tPA is given is referred to as the door-to-needle time. The Best Practice Guidelines for Stroke recommend a target time of less than 60 minutes. Cases reaching RUH within the treatment window of 4.5 hours were included in this analysis.

TABLE 4.6

Door to needle times for tPA

Door-to-Needle Time in Minutes					
	n	Minimum	Maximum	Mean	Std. Deviation
Minutes	20	29	214	70.05	44.519

Many cases underwent tests during their hospitalization to establish the etiology of the stroke. These tests included a second CT scan (n=84), CT angiogram (n=68) to assess plaque formation in the carotid arteries, a carotid ultrasound (n=126) for those who would not be able to tolerate a CT angiogram, and echocardiogram (n=144) to assess the heart as a possible source of cardioembolic emboli, an MRI (n=42) to detect small strokes, and a Holter monitor (n=130) to assess the rhythm of the heart and detect paroxysmal atrial fibrillation. Table 4.7 summarizes the in hospital tests completed for the sample population.

TABLE 4.7

Investigative Tests Completed during the Hospitalization Period

Category	Frequency	Percent
	n = 197	%
CT scan	197	100
CT angiogram	68	35
carotid ultrasound	126	64
echocardiogram	144	73
MRI	42	21
Holter monitor/telemetry	130	66
2 nd CT scan	84	43

The discharge destination provides some insight into the independence of the individual on hospital discharge. Table 4.8 indicates 72 of the cases (37%) returned to their own homes following their hospitalization, and 32 cases (16%) were transferred directly to rehabilitation for their physical disabilities. A total of 30 (15%) required long term care following their cerebrovascular accident, while 39 (20%) were transported back to a hospital in their home community for continued medical and nursing care, and 4 (2%) were transferred to palliative care at another hospital in the city. There were 20 (10%) patients who did not survive their stroke.

Table 4.8
Discharge destination of study population

Category	Frequency N = 197	Percent* %
Home	72	36.5
Rehabilitation	32	16.2
Long term care	30	15.2
Home hospital	39	19.8
Deceased in hospital	20	10.1
Palliative care Saskatoon	4	2.0

Of the cases in the study arriving to hospital within the time to treat with thrombolytics, 20 cases (12%) were administered tPA, the drug therapy. Table 4.9 indicates that of these cases, 45.0% were able to return home, and another 20% were transferred to a rehabilitation program where they may have been able to return home at some point. Another 35% were transferred to long term care on discharge or to their home hospital for ongoing nursing care. One case was not independent prior to admission. Their ages ranged from 58 to 91 years of age with a mean of 76.7 years \pm 8.4 STD.

Table 4.9

Discharge destination following hospitalization for cases receiving acute thrombolytic therapy

Gender	Home n=9	Rehabilitation n=4	Long term care n=3	Home hospital n=4	Total n=20
Male	7	2	1	2	12
Female	2	2	2	2	8

4.4 Performance Measures from the Canadian Best Practice Recommendations for Stroke as they Relate to Study Results

Performance measures were developed to monitor the impact of implementing the best practice recommendations on the quality of patient care and/or patient outcomes (CSN, 2011). Four study variables were selected for comparison to these performance measures.

4.4.1 Performance Measure One

Acute blood work, including routine chemistry, electrolytes, hematology and coagulation should be conducted as part of the initial evaluation (Lindsay et al. 2009)

The current research showed the 174 of the 197 cases had phlebotomy done for routine blood work within the first 7 ½ hours after registration with a mean time of just greater than one hour and standard deviation of 1 hour 20 minutes. The remaining 23 cases were transferred from another facility where phlebotomy was done. Results from other health facilities are not retained in charts at Royal University Hospital although they are used for initial assessment where possible. In some cases, physicians noted the use of referring facility results where in other cases, results were noted with no documentation of their origin and the same results were not found in the RUH case chart. It was not possible to accurately assess the number of cases where out of hospital results were used in the initial assessment. This may have affected the study

results where the phlebotomy time recorded was done in follow up to those from another facility resulting in longer than expected times for phlebotomy.

4.4.2 Performance Measure Two

Electrocardiogram and chest X-ray should be completed, especially where the patient has a clinical history or evidence of heart disease or pulmonary disease (Lindsay et al. 2009).

Electrocardiograms (175) were performed on admission with a mean time of one hour twenty five minutes and a maximum time of 12 hours 25 minutes. The minimum time is recorded as 0 minutes because it was done within RUH immediately prior to the completion of the registration process. The remaining 22 cases registered with a completed ECG from another facility as noted in the physician assessment.

4.4.3 Performance Measure Three

All patients with suspected acute stroke or transient ischemic attack should undergo brain imaging (MRI or CT) immediately (Lindsay et al. 2009). The more specific measurement is the proportion of stroke patients who receive a brain CT/MRI within 60 minutes of hospital arrival.

There were 61 cases where CT was completed within 60 minutes representing 31% of cases.

Another 28 (14%) were completed at a referring hospital prior to admission leaving 55% of cases waiting greater than one hour. Not all cases would have been considered acute and the study did not collect information on whether the cases were considered stroke or not.

4.4.4 Performance Measure Four

Percentage of patients discharged to their home or place of residence following an inpatient admission for stroke (Lindsay et al. 2009).

There were 70 cases that were documented as returning to their place of residence at discharge from the hospital. Of the cases admitted, 80% were documented as living independently, but

only 36.5% were considered independent at discharge. It appears that for 43.5% of the cases who were considered independent on admission, the ability to live independently was lost.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

5.1 Question One

What are the characteristics of the people experiencing strokes in Saskatchewan, relating to their age, race, gender, independence, location of their home community, risk factors, and previous medications to control those risk factors?

A discussion of the similarities and differences between people experiencing stroke in Saskatchewan and those observed in National and International studies will be considered in the following sections.

5.1.1 Demographic description of stroke cases

National and international information outlining major risk factors for stroke currently guide prevention and treatment strategies in Saskatchewan. The information gathered through the performance of this research is uniquely local, however much of the information gathered with respect to risk factors and types of stroke support the national and international findings. This unique local information is important if it can be used to improve programs and planning that result in improved stroke outcomes.

Travel distances to hospital and area of residence are factors unique to Saskatchewan residents. These factors are variable among residents and will affect the time to diagnosis and treatment of stroke. Although these factors are not considered valuable for comparative purposes in this case, travel distance to hospital and area of residence are important demographic features to gather to facilitate the development of regional programs. The results of this study support much of this information provided at a national level with respect to risk factors and types of strokes (CSN, 2011; Kapral et al., 2002).

5.1.1.1 Age and gender

Age is a non-modifiable risk factor for stroke with an increase in incidence associated with aging (Asplund et al., 2009; CSN, 2011; Elias et al., 2004; O'Donnell et al., 2010). Men and women were found to be affected equally by stroke in the population included in this study. Subtle gender differences were observed in relation to age when the age was grouped into 10 year increments. For example, 30 female stroke cases were observed in the age range of 76 to 85 as compared to 18 male stroke cases observed in the same age range. Conversely, in the 66 to 75 year age range, there were more than double the number of male cases (25) as there were females (12). The higher number of strokes at a younger age in men in this study is similar to the 2009 Canadian audit of stroke and could have implications for programs targeting younger men in awareness and prevention programs (CSN and HSFC, 2010). Although these differences are not fully understood, recognition of gender differences may help with interventional treatment programs.

Gender differences have been noted by stroke type (De Rooij, et al., 2007; O'Donnell et al, 2010; CSN, 2011). In the present study, only seven cases of subarachnoid hemorrhage were observed and of these cases there did not appear to be any gender differences. Intracerebral hemorrhage was noted in 24 of the stroke cases admitted to the RUH. The sample of intracerebral hemorrhages was small and a larger sample would be required to make any inference as to possible causes for the difference however, a higher proportion of men than women in the 55 to 64 year age range was noted in the study. No other notable differences were observed in the other age ranges utilized in this study.

Several studies have investigated gender differences in stroke (CSN, 2011; D'Agostino et al., 1994; Elias et al., 2004; O'Donnell et al., 2010). The Canadian Stroke Audit demonstrated that

of all stroke cases studied here, there was an equal distribution of stroke incidence among men and women. For example, of the stroke cases reviewed in the audit, 50% of the cases were men and 50% were women. More specifically the CSN results from Saskatchewan showed 45% were men and 55% were women (CSN, 2011). In the present study, similar findings were observed where of the total stroke cases studied, 53% were men and 47% were women. Gender differences appear to be related to sample size rather than regional differences. Similar findings were reported in an extensive Danish study which included over forty thousand cases. Olsen, (2011) reported that of the 40,000 cases, 52% were men and 48% were women with a similar average age.

Age and gender are significant factors to evaluate when studying stroke for the purpose of treatment, education and prevention (Go et al., 2010; Luengo-Fernandez et al., 2009). One major reason for evaluating gender differences is to focus and inform awareness campaigns and prevention programs. The description of this regional stroke sample supports the national information available that shows no difference in gender overall. Primary prevention education as well as awareness and interventional programs that can be gender neutral in their planning with a focus on younger men to reduce the potential for multiple risk factors as well as programs to educate women on the reduction and control of their risk factors as they age.

5.1.1.2 Stroke type

The risk factors for stroke differ between stroke sub-types which makes the information of what type of stroke is most common extremely important in prevention programs and in the planning of acute stroke care (Kapral et al., 2004; Lindsay et al., 2010; Young and Hachinski, 2003). The majority of stroke cases in this research (84%) were ischemic rather than hemorrhagic which is consistent with national data shown in national information where 80% were ischemic (CSN,

2009; PHAC, 2009). Of these ischemic strokes, 12% were classified as TIAs which is somewhat lower than the CSN findings of 17%. The lower percentage of TIAs admitted to RUH could possibly be contributed to the presence of a stroke prevention clinic for referral as an alternative for admission to hospital. Not all centres in the CSN findings had access to a stroke prevention clinic as an alternative to admitting the case for diagnostic testing. Data from the emergency room and the SPC would need to be examined in conjunction with admission records to gain a clearer understanding of the actual rate of TIAs accessing treatment at RUH.

Women in this study were admitted for TIA twice as often as men during the study period. This result differs from national results for reasons that are unclear. Two possible explanations could include referrals of more men to the SPC than women, or that more women sought help for their symptoms than did men. Further research that included the emergency room records of stroke referral as well as admission are needed to provide adequate information to form conclusions. Of the 23 TIAs admitted, the only observable difference between genders was that in the women over 85 years, there were seven cases compared to one male case. The overall results for hemorrhagic strokes was 16% compared to 15% reported in national statistics and 16% in the national audit of 2008/2009 (CSN, 2011; PHAC, 2009). Of the hemorrhagic strokes, there were three times as many intracerebral as subarachnoid strokes and the number of subarachnoid hemorrhages (SAH) was higher in women than found in men. Conversely, the research indicated a slightly higher percent of men than women with ICH. All of the results for hemorrhagic strokes concur with previous Canadian research indicating that there are no regional differences in this category of stroke (CSN and HSFC, 2010; PHAC, 2009).

Table 5.1 and 5.2 show the stroke types by gender found in this study and those reported by the Canadian Stroke Audit (CSN, 2011) in their results. Small differences are observed, but in

general the sample taken for the Canadian audit supports the results in this study. Gender differences are seen in TIA where this study demonstrated twice as many women as men admitted. Since 2008/09 when the CSN audit took place, and prior to this study in 2009/10, the introduction of a stroke prevention clinic was made that may have impacted the number of admissions for TIA. The Canadian audit results included more than 38,000 cases as taken from chart reviews while the study at RUH included 197 cases

Table 5.1

Stroke type by gender as found in the chart review of cases at Royal University Hospital

Current study results RUH	Ischemic Stroke	Transient Ischemic Attack	Intracerebral Hemorrhage	Subarachnoid Hemorrhage	Total
% of Total Strokes	72	12	12	4	100
% Occurring in Women	47	67	42	60	49
% Occurring in Men	53	33	58	40	51

Table 5.2

Stroke type by gender as found in the Canadian Stroke Audit

Canadian Audit	Ischemic Stroke	Transient Ischemic Attack	Intracerebral Hemorrhage	Subarachnoid Hemorrhage	Total
% of Total Strokes	63	17	11	5	100
% Occurring in Women	49	51	47	60	50
% Occurring in Men	51	49	53	40	50

5.1.1.3 Independence

The impact of lost independence has far reaching effects on families, communities and the health care system (PHAC, 2009; PHAC, 1993). Independence prior to the acute stroke event was determined by recording living conditions prior to hospital admission. In the present study 80% of cases were previously living independent lives. This sample result is supported by other studies that gathered prospective data using a tool that measures a person's daily functioning (Luego-Fernandez et al., 2009). This includes specifically their activities of daily living and

mobility. These studies also found that the majority of stroke cases were living independently prior to admission to hospital (Mahoney and Barthel, 1965; Luengo-Fernandez et al., 2009). Caro, Huybrechts, & Kelly (2001) found in a study of 1446 acute stroke cases that 82.9% had a Barthel Index score of 100 representing independent living prior to admission. Information on the independence of cases prior to their stroke is necessary for calculating the impact of stroke in care costs and lost productivity. The impact of stroke in Saskatchewan through lost independence is unknown and although it is acknowledged, more research is required to accurately measure the scale of that impact.

5.1.1.4 Home location – area of residence

The location of residence prior to stroke has an impact on the ability to reach a RUH in time to receive thrombolytic therapy. The majority of cases were observed to come from Saskatoon. Saskatoon is an area with the greatest population and residents within this region have access to the RUH through available transport. Rural health regions with no large centres capable of diagnostic imaging such as Heartland had a higher representation than those with diagnostic equipment and the ability to treat stroke with thrombolytic therapy such as Parkland. The remote health regions had minimal representation in the sample. This could be explained by the lower overall population base in these regions or the inadequacies of transportation and services leading to fewer cases being referred to a stroke centre for acute treatment. Sparsely populated remote rural areas as defined in Appendix C have no large urban centres equipped to treat acute strokes. Additionally the lack of CT scanners in these areas makes treatment, even by telehealth impossible.

Saskatchewan's Health Regions have substantial differences in total population and ability to reach RUH for treatment as seen in the representation by health region of stroke cases admitted.

There are few hospitals in the sample regions able to provide CT scanning and only one with neurology and neurosurgery services. Remote rural regions have limited access to acute stroke treatment as seen in the number of admissions from these regions to RUH. Stroke prevention strategies to control risk factors are vital in these regions where treatment is not readily available. New approaches are needed to treat stroke in remote rural regions when strokes do occur. Plans to introduce telehealth in these areas have not yet come to fruition and the lack of medical imaging remains a barrier as does transportation times. Much work and planning is needed to provide adequate solutions to these problems.

5.1.1.5 Transportation to hospital

Transportation to hospital is a key factor in the treatment of stroke (Broadley and Thompson, 2003). The type of transportation used to reach hospital has a key impact on the limited time available to treat ischemic strokes with thrombolytic therapy and interventional therapies for hemorrhagic strokes. In this study sample, the majority of cases arrived by ambulance, one quarter by private transportation and less than 10% by air ambulance. In the Canadian Stroke Network (CSN) 2008-2009 audit of Canadian hospitals, a similar number of stroke cases were reported to arrive to hospital by ambulance (CSN, 2011). Although 69% of the cases arrived at RUH by ambulance, only 33% were within the treatment window of 4 ½ hours that would make them eligible for thrombolytic therapy.

A study of 284 acute stroke cases in South Australia reported 35% of cases reached hospital in less than 3 hours (Broadley and Thompson, 2003). They found that location at stroke onset was the only independent predictor of time to admission and that those living within metropolitan areas reached hospital in time to qualify for thrombolytic therapy more often than those in rural areas. Since the Broadley and Thompson (2003) study, advances have been made in public

awareness, the treatment window has been increased, and protocols have been put in place to expedite stroke cases to hospital (Lindsay et al., 2008). Despite these improvements, our percentage of cases arriving at hospital within the treatment window is less than those in the Australian study. With nearly 54% of the study cases coming from the urban centre of Saskatoon, our performance could be improved. Saskatchewan has major geographic challenges in overcoming the unacceptable transportation times currently experienced in its remote rural regions and will require creative approaches to surmount the issues.

Stroke cases reaching hospital just outside the therapeutic window, between 4.5 and 6 hours after symptom onset, represent cases where quicker action might change outcomes, increase treatment options and be a target for further examination. Early treatment of stroke symptoms increases the possibility of better long term outcomes and decreases the costs associated with long term care. Delays in treatment are costly in both physical and mental deficits as well as the financial burdens placed on the system related to extended hospital stays and long term care (Caeiro, Ferro, & Figueira, 2012; Geffner, Soriano, Perez, Vilar, & Rodrigues, 2012). Increasing the availability of CT scanners in centres throughout the study regions combined with telehealth capabilities in these centres would provide the expertise of a neurologist to oversee the administration of thrombolytic therapy prior to transport for continued management under their care. Increased awareness of the urgency required in seeking medical attention could decrease transportation times by encouraging people in the recognition of symptoms and to call an ambulance as opposed to private transportation.

5.1.2 Description of personal information

5.1.2.1 Risk factors and their relationship with age and gender

Hypertension, dyslipidemia, diabetes, and atrial fibrillation are risk factors that can be controlled with medications. Age, previous stroke or TIA are examples of risk factors that cannot be changed while others such as smoking, obesity, and alcohol abuse can be controlled through lifestyle modifications. A single risk factor for stroke is much more manageable than multiple factors sometimes categorized as a metabolic syndrome (Cronin & Kelly, 2009; Boden-Albala and Sacco, 2008). Zhang et al (2011) found in a meta analysis of European and US studies that as people age, the incidence and prevalence of stroke increases with men generally having a higher incidence than women. Studies to date have not correlated the number of risk factors with age and gender.

This study found that 39% of the stroke cases were between the ages of 55 and 75 years. A trend was also observed between age and number of risk factors for stroke. Sixty-one percent of stroke cases within the ages of 55 to 75 were found to have three or more risk factors and two cases presented with a total of eight risk factors. It was also noted that 17% of cases between the ages of 55 and 65 presented with more than three risk factors. Seventy-six percent of men within this age group and 24% of women presented with more than 3 risk factors. In the present study it was also observed that the percentage distribution of risk factors for men and women varied with age group. Men in this research had higher risk than women from age 55 to 75 with the highest risk from age 65 to 75 based on the number of risk factors per case. After age 75 the risk in women surpassed that of men and remained higher with the greatest risk for women between age 75 and 85. No sources were found in the literature to support this observation.

From the total cases identified during the study period, the four most common risk factors identified were hypertension, dyslipidemia, cardiac artery disease, and diabetes. Hypertension has been identified in other studies as a major factor in the risk of stroke and was confirmed in this cohort as were dyslipidemia, cardiac disease and diabetes (WHO, 2006). In addition to these major risk factors, nearly one quarter of these cases were also smokers or had quit within the previous five years.

5.1.2.2 Medication use

Medication use was gathered to indicate the pharmacological management of risk factors for stroke. Medications examined in the study were specific to known risk factors for stroke and these included most predominantly those for hypertension, diabetes, atrial fibrillation, and previous TIA or stroke. Patient history on admission demonstrated that not all participants were using medications for the treatment of stroke associated risk factors. There are a number of possibilities to explain this finding that would include adherence issues, under prescribing by physicians, or errors in documentation. Osterberg and Blaschke (2005) recognize that “the full benefit of the many effective medications that are available will be achieved only if patients follow prescribed treatment regimens reasonably closely” (p. 487). O’Rourke et al., (2004) suggests that family physicians and specialists need to aggressively treat the risk factors for stroke through pharmaceutical interventions where other interventions such as lifestyle modifications have not been or are not yet effective. The many possibilities for what appears to be the under treatment of risk factors were not explored in this research but a lack of adherence to prescribed medications or under prescribing could both explain the lack of treatment. The use of medications for the control of risk factors included in this study will be discussed in the context of the individual risk factors.

5.1.2.3 Hypertension

Hypertension has been shown to be a major risk factor for stroke in the literature (Robitaille et al., 2012; Roger et al., 2011). The INTERSTROKE study was the first large standardized case-control study of risk factors for stroke in which countries of low and middle income were included and all cases completed neuroimaging (O'Donnell et al. 2010). O'Donnell et al showed that hypertension was the most important risk factor for all stroke subtypes. In the present study, the majority of cases, 88%, were documented with a previous diagnosis of hypertension. Of these cases, 12% did not have a currently filled prescription for any hypertensive medication suggesting uncontrolled blood pressure.

The Canadian statistics in the recent stroke audit demonstrated that 64% of stroke cases had existing hypertension. The current research revealed similar results of hypertension in comparison to other studies (CSN, 2011; Elias et al., 2004; Go et al., 1997; O'Donnell et al., 2010; Robitaille et al., 2012). In this study population it was determined that 81% of the cases have a previous history of elevated blood pressure. The Saskatchewan sample results are well above the Canadian findings and should be further investigated for underlying causes and the results to be shared with health care professionals involved in primary prevention. In previous studies the underlying causes of hypertension were reported to include sedentary lifestyles, smoking, obesity, excessive alcohol consumption, high fat diets, and excessive salt intake (PHAC, 2009; James et al., 2004). With the exception of smoking and obesity, these factors could not be examined in this study however, the high rate of hypertension in this population warrants further enquiry into the predominant Saskatchewan causes of hypertension and solutions for their reduction.

5.1.2.4 Diabetes, cardiac artery disease, and atrial fibrillation

The microvascular and macrovascular complications of diabetes create one of the most significant risk factors for ischemic stroke (CSN, 2011). Fifty five cases were reported to have diabetes in the stroke population studied. Daily injectable insulin or oral medications were taken by 42 of the diabetics identified. Three diabetics were found to be taking both insulin and an oral medication. It is a possibility that those individuals not taking medications could have been considered borderline diabetic controlling their disease with diet or they could be non-compliant with medications prescribed for them (Krueger, Felkey, and Berger, 2003). Further information on the status of diabetes or medication usage was not collected in this research. Future studies looking at stroke and diabetic control could look at more specific measure of diabetic control by collecting information on blood glucose levels at the time of admission or a hemoglobin A1C measuring longer term control. However these data provide insight into the level of diabetic control in the stroke cases identified and provide rationale for further investigation into glycemic control at the time of admission to hospital and also to the effectiveness of disease control measures.

Diabetes and cardiac artery disease (CAD) had comparative representation in this study sample to that of the national findings (CSN, 2011). Diabetes and CAD were found in 27% and 29% of cases respectively upon admission to RUH. Canadian statistics on cardiac artery disease compared similarly to that of Saskatchewan stroke population studied (CSN, 2011). The Saskatchewan sample had a somewhat higher history of diabetes with 29% compared to the Canadian results of 24%. This difference may be due to sample size, or for reasons related to a higher instance of diabetes in Saskatchewan (PHAC, 2012). Provincial statistics illustrate the prevalence of diabetes in Saskatchewan is increasing. It has been shown that diabetes incidence

has increased from an 8% of the population in 2005 to 11% in 2010 (PHAC, 2012). The most recent national information (2008/2009) shows that 6.8% of the population is affected by diabetes and Saskatchewan is one of the four provinces showing the greatest increase over the previous 11 years (PHAC, 2012). The Public Health Agency of Canada also reports “the socio-cultural, biological, environmental and lifestyle changes seen in the First Nations, Inuit and Métis populations in the last half century have contributed significantly to increased rates of diabetes and its complications” (chapter 6, para. 4). With the sixth highest Aboriginal population in the country, the difference could also be contributed to the high rates of diabetes among Aboriginal populations in Saskatchewan. Due to the inability to collect ethnic information in hospital records, no conclusions can be made regarding the possibility of higher risk of stroke by ethnic origin.

Atrial fibrillation alone accounts for up to 15% of the strokes seen in Canada (PHAC, 2009). Analyzing the use of medication for atrial fibrillation is difficult since cases with no prior history of stroke or TIA may be managed with heart rate control medications (Wann et al. 2011). The use of anticoagulation for atrial fibrillation is indicated following a stroke or TIA with the exception of those at risk of bleeding complications (Lindsay et al., 2008). Of the 166 cases of ischemic stroke identified, 21.1% had a diagnosis of atrial fibrillation however, only 40.0% of the cases demonstrated the use of an anticoagulant. In addition, 37.9% of cases indicated a previous history of stroke or TIA which would indicate the need for medications used in secondary prevention; however 38.1% of these cases were not taking Coumadin or Clopidogrel where the risk of bleeding was too high to use Coumadin. There were 48.2% of cases where the patient was taking ASA; a medication that can be used in primary or secondary prevention making it not possible to accurately calculate the number of cases adequately treated with the

appropriate medication. It is unclear from this study information whether the use of these medications was for primary or secondary prevention. Future research should explore the use of medications for stroke treatment and prevention on the basis of first or second stroke or TIA to clarify issues around the intended use of medications.

5.1.2.5 Dyslipidemia

Dyslipidemia has long been recognized as a significant risk factor for stroke for more than a decade (Hachinski et al. 1996; Amarenco et al. 2009). Nearly half of the study cases had a documented diagnosis of dyslipidemia and 69% of the stroke cases with the diagnosis of dyslipidemia were not currently taking a lipid lowering medication. Initial studies such as the MORGAM study did not find an association between cholesterol levels and risk of stroke however, several large trials such as the SPARCL trial and the Framingham Heart Study have concluded that the risk of a cardiovascular event is lowered by 30% with the use of lipid lowering medications (Amarenco et al., 2009; D'Agostino et al, 1994).

5.1.2.6 Obesity

Obesity has been linked with cardiac artery disease, diabetes, and hypertension and has been identified as one of the five risk factors responsible for more than 80% of the global risk of all stroke (Strazullo et al. 2010; O'Donnell et al. 2010). It was difficult to analyze obesity in the Saskatchewan stroke case population because case documentation of obesity was absent in 70.7% of the stroke cases admitted to RUH. However, non-obesity and morbid obesity were noted in 22.8% and 6.5% of the cases respectively.

Recent studies have examined obesity and stroke and found that obesity as measured by body mass index, is linked to stroke (Go et al., 2010; James et al., 2004; Lakka and Laaksonen, 2007). Weight as part of BMI may not be the best indicator to use in assessing stroke risk. More specifically the SPARCL trial examined the categorization of weight in over 4700 cases of stroke in which the average weight fell within the overweight category. The study found that with accurate recording of weight, a higher number of cases in the overweight or obese ranges become apparent (Amarenco et al. 2009). Recently, the INTERSTROKE study has shown that

even in cases where obesity was not indicated, the measurement of abdominal girth was a better indicator of stroke risk (O'Donnell et al. 2010). BMI or waist measurement not routinely recorded in hospital charts that were reviewed. Although obesity is becoming more prevalent in our society this is not reflected in the documentation found in the hospital records (James et al. 2004; PHAC, 2012). The under reporting of obesity is an issue in terms of stroke prevention and perhaps is an indicator of inadequate record keeping for this particular risk factor. Additionally, the failure of to record and recognize obesity as a major risk factor of stroke does not facilitate a plan for current or future weight loss programs for individuals at higher risk for stroke. Bardia et al., (2007) examined the documentation of obesity in medical records and concluded that obesity is not routinely documented by physicians. Obesity is a major public health concern and without documentation, formal weight loss plans will not be initiated to help control this major health issue (Bardia et al. 2007). Waist circumference would be relatively easy to measure during an acute stroke event and gives a better indication of stroke risk.

5.2 Question Two

What types of treatments are provided to stroke cases at the Royal University Hospital and how do they compare to national guidelines for timeliness and comprehensiveness during the acute and hospital phases of care?

5.2.1 Description of acute management

5.2.1.1 Door to needle times

The time to treatment is an essential aspect of stroke patient care. The healthcare system assumes responsibility for swift and efficient care when stroke cases reach the hospital door. The three factors examined in this study regarding door to needle times were time to phlebotomy, ECG and CT scan. Critical to any hospital's acute stroke protocol is the rapid recognition and action

required to have a CT scan done, to rule out the possibility of a hemorrhagic stroke, blood work done to ensure that PTT and INR values lie within the criteria for the use of thrombolytic therapy (tPA). As well, an ECG is also required for cardiac rhythm assessment. Treatments for hemorrhagic strokes are dealt with through medical or surgical intervention depending on the severity of the bleed, but also require rapid assessment including phlebotomy and ECG.

The expectation for phlebotomy and ECG times is that they are done as soon as possible following registration (Lindsay et al. 2010). Excluding those who came with results for these tests already completed, the times recorded in the current study varied from immediate for both tests to nearly 1.5 hours for phlebotomy and 2 hours for ECG.

The Canadian Audit found that only eight percent of cases being admitted with ischemic stroke across the country received treatment with tPA (CSN, 2011). The CSN also noted that in the province of Saskatchewan, ten percent of stroke cases admitted with ischemic stroke are treated with tPA (CSN, 2011). The CSN results for RUH also showed a ten percent treatment with tPA. Although in the current study 33% of cases arrived within the potential treatment window. This would indicate that there were 23% of cases in the treatment window time did not meet the inclusion criteria for treatment with tPA. This research did not look specifically at the reasons for thrombolytic therapy exclusion however; this information would be valuable for strategies to increase therapy rates.

The Canadian Best Practice Recommendations for Stroke state thrombolytic therapy should be started in less than one hour for the cases arriving within 4 ½ hours from onset of symptoms.

There were 23 cases recorded as having been given tPA admitted to hospital in this research however, three of these cases had received therapy at another institution and subsequently transferred to RUH. Of the 20 cases receiving tPA at RUH, the minimum door to needle time

was 29 minutes and the maximum was 214 min. with a mean time of 70 min. The maximum and mean times are in excess of 1 hour indicating that there is room for improvement in this area.

The Canadian Stroke Audit completed by CSN and HSFC (2011) found that “in two-thirds of the cases where tPA was administered, the door-to-needle (arrival to administration) time was greater than one hour, with a median time of 72 minutes” p.21. It appears that the Royal University Hospital exceeds the national average for the number of cases treated with tPA and meets but does not exceed the national average in the time taken for the treatment to be initiated. Common impediment to treatment can include delays in lab results, lack of available history or equipment failures. It is also possible that more time was taken with cases arriving with ample treatment time however; this information was not included in the study.

5.2.1.2 In hospital care

The Canadian Best Practice Recommendations for Stroke Care states that “when a patient with a stroke is admitted to hospital it is important that the care he/she receives is focused on recovering from the stroke, preventing complications, and preventing a recurrent stroke” (CSN and HSFC, 2011). The results of this study revealed that every case in the study received a CT scan, and almost half of the cases studied received a second scan while in hospital. Tests to discover the etiology of the stroke included a carotid ultrasound, echocardiogram, and Holter monitoring. These tests were completed on the majority of stroke cases while in the RUH. MRI’s were completed on only 21% of the cases possibly because the CT scan gave the same basic information required to manage most strokes and the additional knowledge gained by an MRI would only be required for harder to diagnose cases. The reasons for some cases receiving certain tests and not others can only be speculated on with the information gained from the study and would require a more in depth study of the individual cases for an explanation.

5.2.1.3 Discharge destination

The impact of stroke is largely determined by how completely cases can resume their former lifestyle (PHAC, 1993; Luengo-Fernandez et al., 2009). The only indication of stroke outcome was the case destination following discharge. Ten percent of patients in this study did not survive the stroke event. The stroke resulted in a loss of independence for the majority of cases. Of the 197 cases in the study, 80.2% were living independently at the time of their stroke however; approximately 55% were unable to return directly to their own homes. Approximately 16% were transferred to a rehabilitation program with the possibility of later full recovery. A percentage of those who qualified for rehabilitation were expected to fully regain their independence, and the remainder to live with ongoing deficits. A total of 54 cases who were previously contributing members of society are no longer able to live independently. This signifies an untold impact on the families, friends and communities involved as well as a considerable financial impact reported as being over 3.6 billion dollars in health care costs (PHAC, 1997; Luengo-Fernandez et al., 2009) The consequences of lost years of productivity in addition to the costs associated with acute care, rehabilitation, and long term care represent the burden of stroke. Much of this burden is incalculable in dollars and cents however; this makes it no less significant in a comprehensive representation of stroke.

5.3 Study Strengths

The sample of cases was randomly selected for the study represented slightly less than half of the total admissions for stroke and TIA in the designated time period of one year. From this sample, information was gained on the nature of stroke management for rural Saskatchewan residents that has not been previously examined in the literature. The study provides an examination of stroke care from admission to discharge.

5.4 Study Limitations

The study was a retrospective examination of health care for stroke cases from hospital records and reflects the problems with routinely collected data when it is used to examine specific care needs related to a diagnosis. No comparisons were made to the total number of strokes and TIAs admitted to Royal University Hospital for the period of April 1, 2009 to March 31, 2010, therefore results of this study may not be representative of the population of Saskatchewan. Limitations to the research also include the inability to identify the ethnic background of cases. The population of Saskatchewan includes a strong representation of Aboriginal people. A large number of these people live in the northern regions categorized in the study as rural and remote rural. Without the ability to collect ethnic information, no support can be given to ethnically sensitive programs or strategies.

Strokes and TIA can occur at any age but only cases 55 years and over were included in this study and the results are therefore not representative of all strokes occurring during the study period. In addition, hospital admissions include only a portion of all stroke and TIA cases occurring in the health regions included in the study and the results presented may under represent the number of strokes and their impact.

The research gathered retrospective data obtained from hospital charts and was therefore limited to what was recorded by the hospital personnel. As a result, a true measure of obesity as a risk factor could not be made with the information available in the hospital chart. In addition, the barriers to medication adherence, delays in seeking treatment and delays in reaching treatment could not be collected.

Functional scales indicating physical and mental ability are not routinely used for stroke and TIA at the Royal University Hospital that would have provided more detailed information on

disability at discharge. Finally, the sample was taken from one fiscal year and represents only a fraction of the stroke cases being admitted to RUH on an ongoing basis and hospital care could differ somewhat from year to year based on hospital policies and current standards of practice for that time period.

5.5 Implications for Practice

Nurses are in a position to play a pivotal role in stroke prevention through the detection and control of hypertension, control of dyslipidemia, and the management of diabetes and cardiac artery disease. The promotion of exercise, healthy diets, and cessation of cigarette smoking are vital at all ages but are of particularly important in aging adults. The study results imply that men tend to have multiple risk factors earlier than women increasing their risk and making them a target for early intervention programs.

Targeted primary prevention strategies to manage multiple risk factors in younger males need to be addressed through both public awareness campaigns and family physician education to promote healthy choices for their patients as they carry out medical management. Women in the study showed a tendency to develop more risk factors as they age and although the same prevention strategies would be beneficial, increased age also brings with it the possibility of age related barriers to risk management for instance decreased mobility, balance, etc. Education and medical management of these risk factors should occur as early as possible with a focus on the dangers posed by multiple risk factors especially in middle aged men and women as they move toward older age.

Controlling risk factors often includes the use of medications that need to be taken as prescribed by their physician to be effective. When non-adherence concerns are recognized, the underlying issues need to be identified and steps taken for positive resolution. Nurses in key locations such

as community health and wellness centres may have an opportunity to facilitate constructive solutions and prevent the elevated stroke risk associated with non-adherence. The reasons for medication non-compliance are complex and specific to each case. Healthcare professionals need to be aware of barriers to sustained use of statins and provide education and provide support directed at the reduction of cholesterol levels to reduce risk. Additional challenges faced by healthcare professionals include education, and encouragement to achieve and sustain behavioral changes to reduce lipid levels.

Stroke and TIA treated in hospital have a record of the treatment received that can be used to measure performance through standards provided in national recommendations (CSN, 2010). Formal tracking of adherence to best practice recommendations through performance measures is not a current hospital practice and the adoption of this practice would have the potential to improve stroke care. The expectation of improved stroke care and treatment should be measurable in the outcomes following discharge (CSN, 2010). These outcomes are not currently tracked past discharge from hospital care. More comprehensive surveillance of stroke outcomes would provide feedback for current in hospital practice and make available a greater understanding of the impact of stroke.

The study showed that two thirds of the cases admitted to Royal University Hospital arrived too late for thrombolytic therapy. Awareness of the signs and symptoms of stroke and the urgency required in seeking medical attention needs to be promoted in every healthcare setting to reduce delays to treatment.

In this study, rural and remotely rural individuals who did not have local access to a CT scanner had longer transportation time which would have put them at risk of being ineligible for thrombolytic therapy. As well, of the 91 previously independent cases that came from urban

centres outside of Saskatoon, rural, and remote rural settings, just less than half were transferred to their home hospital following their acute treatment unable to return to their homes as they were not a candidate for rehabilitation at the time of their discharge.

The Canada Health Act guarantees portability, universality, comprehensiveness, and accessibility to health care for all Canadians (Government of Canada Department of Justice, 1985).

Obviously in this study these criteria were not being met for acute stroke cases. Access to CT scanners and a neurologist by telehealth could improve the quality of life of ischemic stroke cases (the majority of stroke cases) post discharge if treatment were readily accessible.

5.6 Conclusion

The research describes the population affected by stroke and admitted to Royal University Hospital for treatment in 2009-2010. In addition to the description, four performance measures were examined to evaluate whether Royal University Hospital met selected Canadian recommendations for stroke care.

In many of the general categories being described such as age, gender and type of stroke, the results of the study closely resemble those of the national audit conducted by the CSN in conjunction with the HSFC. The similarity of results provides a sense of confidence in using national statistics for future studies and programs relying on this information to be representative of the Saskatchewan population. The study also identified areas where there is need for improvement such as the arrival times for treatment recognizing that two thirds of the cases did not arrive in time to be considered for thrombolytic therapy. The use of national performance measures provides a tool for evaluation of stroke care practices is recommended for the Royal University Hospital. The evaluation is an important step towards excellence in stroke care for this regional stroke centre.

All regions of the province do not have equal accessibility to stroke care with only a third of the rural cases and none of the remote rural cases arriving to Royal University Hospital in time for acute ischemic stroke treatment options. Solutions are needed to address the barriers faced by residents of these regions to access treatment rapidly. While solutions are developed to reduce delays in accessing to treatment, primary prevention of stroke through medical management and effective programs to promote lifestyle changes are essential.

The number of risk factors experienced in the cases being admitted showed that men tend to have a greater number of risk factors at an earlier age whereas women tend to accumulate risk with age. Additional research in this area to discover the reasons for this difference could provide valuable educational tools to enable the reduction of modifiable risk factors for both men and women. In many of the cases, the case history showed multiple known risk factors for stroke although in many cases medications known to be used in the treatment of these factors were not currently prescribed. Future research into the possible causes of this finding could be used to re-frame approaches to prevention strategies and further reduce the risk of stroke.

The care of stroke cases during their hospitalization at Royal University Hospital met the selected performance standards from the Canadian Best Practice Recommendation for Stroke (2010).

Despite this fact, nearly half of the cases who had been living independent lives prior to their stroke required complete or partial care at hospital discharge. The lost years of productivity as well as the ongoing costs associated with continuing care have a substantial impact on families, communities and the province. Again, the uptake of performance measure as a hospital function has the potential to reduce this impact, and could be utilized to identify areas for the improvement of outcomes and promote the highest standard of care. This study provides a description; including relevant health history, for 197 stroke cases admitted to Royal University

Hospital, the care they received while in hospital and their ability to live independent lives at the time of their discharge. Several areas have been identified where additional investigation could provide information to inform health professionals in their efforts to improve stroke prevention and care in Saskatchewan.

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APPENDIX A: Data Collection Tool

Saskatchewan Stroke Enquiry

Bio # _____

Data Collection Tool

1. SUBJECT # _____

2. Gender: ☐ male ☐ female

3. Age _____ yrs.

4. Community: ☐ Saskatoon ☐ Urban ☐ Rural ☐ Remote rural

5. Date of registration in Emergency dept. (dd.mm.yy) _____.____.

6. ETHNICITY (self identified): ☐ Aboriginal – Status ☐ Aboriginal – non-status

☐ Afro-Caribbean ☐ Caucasian ☐ Inuit ☐ Métis ☐ Middle Eastern ☐ unknown

☐ Oriental ☐ Other – specify: _____

7. Did the case live in their own home or that of a relative but were independent prior to the event? ☐ no ☐ yes ☐ unknown

RISK FACTORS

DID THE CASE HAVE:

8. Hypertension ☐ no ☐ yes ☐ unknown

9. Diabetes ☐ no ☐ yes ☐ unknown

10. Dyslipidemia ☐ no ☐ yes ☐ unknown

11. Obesity ☐ no ☐ yes ☐ unknown

12. Alcohol abuse (>5 drinks/wk) ☐ no ☐ yes ☐ unknown

13. Smoking ☐ no ☐ yes ☐ unknown ☐ stopped ☐ never smoked

14. Family history of stroke ☐ no ☐ yes ☐ unknown

15. Previous ischemic stroke ☐ no ☐ yes ☐ unknown

16. Previous TIA ☐ no ☐ yes ☐ unknown

17. Previous intracranial hemorrhage ☐ no ☐ yes ☐ unknown

CARDIAC RISK FACTORS

18. Previous myocardial infarction ☐ no ☐ yes ☐ unknown

19. Cardiac artery disease ☐ no ☐ yes ☐ unknown

20. Previous cardiac surgery ☐ no ☐ yes ☐ unknown

21. Previous atrial fibrillation ☐ no ☐ yes ☐ unknown

22. Congestive heart failure ☐ no ☐ yes ☐ unknown

PREVIOUS MEDICATIONS TO TREAT

23. Was the case on asa prior to event? ☐ no ☐ yes ☐ unknown

24. Was the case on clopidogrel prior to event? ☐ no ☐ yes ☐ unknown

25. Was the case on warfarin prior to event? ☐ no ☐ yes ☐ unknown

26. Hypertension ☐ no ☐ yes ☐ unknown

27. Diabetes non insulin dependent ☐ no ☐ yes ☐ unknown

28. Diabetes insulin dependent ☐ no ☐ yes ☐ unknown

29. Hypercholesterolemia ☐ no ☐ yes ☐ unknown

30. Arrival at hospital was by: ☐ ambulance ☐ private transport ☐ air ambulance

31. Elapsed time from onset of symptoms (as determined by physician) to the time of registration if less than 4.5 hours (on the registration sheet). (In minutes)

32. Elapsed time from onset of symptoms (as determined by the physician) to the time of registration if greater than 4.5 hours:

☐ 4.5-6 hrs ☐ 6-12hrs ☐ 12-24hrs ☐ >24hrs

33. Was asa given prior to arrival at hospital? ☐ no ☐ yes

34. Was asa or clopidogrel (plavix) given in the emergency department?

☐ no ☐ yes

35. Time or registration _____(24hr)

36. Time of CT scan _____(24hr) *if less than 24hours*

37. Did the case receive tPA? ☐ no ☐ yes

38. Time of tPA administration)? _____(24hr)

38. Date of admission to hospital (dd.mm.yy) __.__.__

TESTS

40. Time of first phlebotomy _____(24hr)

41. Did lab requisition include electrolytes, cbc, INR, & glucose. ☐ no ☐ yes

42. Time of electrocardiogram _____(24hr)

43. second CT scan ☐ no ☐ yes

44. CT angiogram ☐ no ☐ yes

45. Carotid Ultrasound ☐ no ☐ yes

46. Echocardiogram ☐ no ☐ yes

47. MRI ☐ no ☐ yes

48. Holter monitor ☐ no ☐ yes

PROCEDURES

49. Was carotid stenosis treated through endarterectomy or stenting while in hospital?

☐ no ☐ yes

TYPE OF STROKE

50. Ischemic ☐ no ☐ yes

51. Intracerebral hemorrhage ☐ no ☐ yes

52. Subarachnoid hemorrhage ☐ no ☐ yes

HOSPITALIZATION

53. Number of days in hospital: _____

54. Discharge destination: ☐ home ☐ rehabilitation ☐ long term care

☐ home hospital (transfer)

APPENDIX B: Code Book

DESCRIPTION OF VARIABLE	VARIABLE NAME	CODING INSTRUCTIONS
IDENTIFICATION NUMBER	id	individual assigned number
GENDER	sex	1= female
		2= male
AGE	age	in years
ETHNICITY	ethnic	1= Caucasian
		2= Aboriginal - First Nations
		3= Aboriginal - not First Nations
		4= Métis
		5= Inuit
		6= Oriental
		7= Black
		8= Middle Eastern
COMMUNITY OF RESIDENCE	comm	1= Saskatoon
		2= urban
		3= rural
		4= remote rural
		5= reservation
PREVIOUSLY INDEPENDENT	indep	1= yes
		2= no
TIME FROM ONSET TO REGISTRATION	time	1= < 1hour
		2= 1 - 3 hours
		3= 3 - 4 1/2 hours
		4= 4 1/2 - 6 hours
		5= 6 - 12 hours
		6= 12 - 24 hours
		7= > 24 hours

DELAY BY INDIVIDUAL/FAMILY IN SEEKING ASSISTANCE	delay	0=no 1= yes 2=unknown
OTHER DELAYS PRIOR TO ARRIVAL	other	0=no 1= yes 2=unknown
ARRIVAL TO HOSPITAL BY AMBULANCE	transp	0=ambulance 1=private transportation
		2=air ambulance
STOPPED AT LOCAL HOSPITAL (referral by FP)	stop	0=no 1= yes 2=unknown
RECEIVED tPA	tPA	0=no 1= yes
DOOR TO NEEDLE TIME	min	number of minutes from registration time to time of tPA start
RISK FACTORS		
HYPERTENSION	htn	0=no 1= yes 2=unknown
DIABETES	ddm	0=no 1= yes 2=unknown
DYSLIPIDEMIA	lipid	0=no 1= yes 2=unknown
OBESITY	obese	0=no 1= yes 2=unknown
ALCOHOL ABUSE	etoh	0=no 1= yes 2=unknown
SMOKING	smoke	0=no 1= yes 2=unknown
		3= stopped 4=never smoked
PAST CAROTIC ENDARTERECTOMY	endart	0=no 1= yes 2=unknown
FAMILY HISTORY OF STROKE OR MYOCARDIAL INFARCTION	fhx	0=no 1= yes 2=unknown
PREVIOUS STROKE	ps	0=no 1= yes 2=unknown
PREVIOUS INTRACRANIAL HEMORRHAGE	ich	0=no 1= yes 2=unknown

PREVIOUS TIA	ptia	0=no 1= yes 2=unknown
PREVIOUS SUBARACHNOID HEMORRHAGE	sah	0=no 1= yes 2=unknown
CARDIAC RISK FACTORS		
PREVIOUS MYOCARDIAL INFARCTION	mi	0=no 1= yes 2=unknown
CARDIAC ARTERY DISEASE	cad	0=no 1= yes 2=unknown
PREVIOUS CARDIAC SURGERY	heartsx	0=no 1= yes 2=unknown
CONGESTIVE HEART FAILURE	chf	0=no 1= yes 2=unknown
ATRIAL FIBRILLATION	afib	0=no 1= yes 2=unknown
INR	inr	actual number
CREATININE	cr	0= within normal range
		1= above normal range, but not 2X upper normal
		2= >2X upper normal range

NIH STROKE SCALE SCORE	nih	actual score
SYMPTOMS		
UNILATERAL WEAKNESS	weak	0=no 1= yes 2=unknown
HEADACHE	ha	0=no 1= yes 2=unknown
SPEECH DIFFICULTY	speech	0=no 1= yes 2=unknown
BALANCE	bal	0=no 1= yes 2=unknown

DIFFICULTY		
VISUAL CHANGE	see	0=no 1= yes 2=unknown
NAUSEA	nausea	0=no 1= yes 2=unknown
FACIAL DROOP	droop	0=no 1= yes 2=unknown

UNILATERAL NUMBNESS AND/OR TINGLING	numb	0=no 1= yes 2=unknown
PREVIOUS MEDICATIONS		
ACETYLSALICYLIC ACID (ASA)	asa	0=no 1= yes 2=unknown
CLOPIDOGREL (PLAVIX)	plavix	0=no 1= yes 2=unknown
STATIN (ATORVASTATIN, SIMVASTATIN, ETC.)	statin	0=no 1= yes 2=unknown
ORAL HYPOGLYCEMIC	niddm	0=no 1= yes 2=unknown
INSULIN	iddm	0=no 1= yes 2=unknown
HYPERTENSION TREATMENT	hyper	0=no 1= yes 2=unknown
WARFARIN (COUMADIN)	warfarin	0=no 1= yes 2=unknown
SOURCE OF STROKE	source	1= cardioembolic
		2= atherothrombotic
		3= other
		4= unknown
DAYS OF HOSPITALIZATION	days	number of days
TESTS		

TRANSTHORASIC ECHOCARDIOGRAM	echo	0=no 1= yes 2=unknown
CAROTID ULTRASOUND	ultra	0=no 1= yes 2=unknown
CT ANGIOGRAM	cta	0=no 1= yes 2=unknown

HOLTER MONITOR	holter	0=no 1= yes 2=unknown
MRI	mri	0=no 1= yes 2=unknown
EEG	eeg	0=no 1= yes 2=unknown
EMG	emg	0=no 1= yes 2=unknown
NERVE CONDUCTION STUDIES	ncs	0=no 1= yes 2=unknown
THROMBOPHILIA SCREEN	lab	0=no 1= yes 2=unknown
DISCHARGE DIAGNOSIS	Dx	0= stroke
		1= TIA
		2= other
DISCHARGE DESTINATION	dest	0= home (independent)
		1= home (with family support)
		2= home hospital
		3= rehabilitation
		4= long term care facility
		5= deceased

APPENDIX C: Defining Communities based on Saskatchewan Health Regions



COMMUNITY:

City of **Saskatoon**

Urban but not including Saskatoon (pop. >5000)

Rural (Sunrise, Saskatoon, Heartland, Prairie North, Parkland, and Kelsey Trail Health Regions not in an urban centre)

Remote Rural (Mamawetin Churchill River, Keewatin Yatthe, and Athabasca Health Regions)

APPENDIX D

INCLUDED ICD CODES

- (I60) Subarachnoid hemorrhage
 - (I60.0) Subarachnoid haemorrhage from carotid siphon and bifurcation
 - (I60.1) Subarachnoid haemorrhage from middle cerebral artery
 - (I60.2) Subarachnoid haemorrhage from anterior communicating artery
 - (I60.3) Subarachnoid haemorrhage from posterior communicating artery
 - (I60.4) Subarachnoid haemorrhage from basilar artery
 - (I60.5) Subarachnoid haemorrhage from vertebral artery
 - (I60.6) Subarachnoid haemorrhage from other intracranial arteries
 - (I60.7) Subarachnoid haemorrhage from intracranial artery, unspecified
- (I61) Intracerebral haemorrhage
 - (I61.0) Intracerebral haemorrhage in hemisphere, subcortical
 - (I61.1) Intracerebral haemorrhage in hemisphere, cortical
 - (I61.2) Intracerebral haemorrhage in hemisphere, unspecified
 - (I61.3) Intracerebral haemorrhage in brain stem
 - (I61.4) Intracerebral haemorrhage in cerebellum
 - (I61.5) Intracerebral haemorrhage, intraventricular
 - (I61.6) Intracerebral haemorrhage, multiple localized
- (I62) Other nontraumatic intracranial haemorrhage
 - (I62.0) Subdural haemorrhage (acute)(nontraumatic)
 - (I62.1) Nontraumatic extradural haemorrhage
 - Nontraumatic epidural haemorrhage
- (I63) Cerebral infarction
 - (I63.0) Cerebral infarction due to thrombosis of precerebral arteries
 - (I63.1) Cerebral infarction due to embolism of precerebral arteries
 - (I63.2) Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries
 - (I63.3) Cerebral infarction due to thrombosis of cerebral arteries
 - (I63.4) Cerebral infarction due to embolism of cerebral arteries
 - (I63.5) Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries
- (I64) Stroke, not specified as hemorrhage or infarction
- (I67.6) Nonpyogenic thrombosis of intracranial venous system

Cerebrovascular

- (G45) Transient cerebral ischaemic attacks and related syndromes
 - (G45.0) Vertebrobasilar artery syndrome
 - (G45.1) Carotid artery syndrome (hemispheric)
 - (G45.2) Multiple and bilateral precerebral artery syndromes
 - (G45.3) Amaurosis fugax
 - (G45.8) Other transient cerebral ischaemic attacks and related syndromes
 - (G45.9) Transient cerebral ischaemic attack, unspecified
- (H34) Retinal vascular occlusions
 - (H34.0) Transient retinal artery occlusion

- (H34.1) Central retinal artery occlusion
- (H34.2) Other retinal artery occlusions
 - Hollenhorst's plaque
- (H34.8) Other retinal vascular occlusions
 - Central retinal vein occlusion
- (H34.9) Retinal vascular occlusion, unspecified

EXCLUDED ICD CODES

- (G45.4) Transient global amnesia
- (G160.8) Malignant neoplasm of other accessory sinuses
- (I63.6) Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
- (C80.0) Malignant neoplasm of other specified sites of pleura